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EFFICIENCY AND SELECTIVITY OF FLAG GILL NETS FISHED IN LAKE BISTINEAU, LOUISIANA

by

Victor W. Lambou
Louisiana Wild Life and Fisheries Commission
Baton Rouge, Louisiana

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Abstract

In order to determine the efficiency and selectivity of flag gill nets in catching game fish, experimental flag gill nets were fished in Lake Bistineau during the period March through August, 1956. Flag gill nets contain no lead line and are hung on a top line which contains no floats. The experimental nets used consisted of the following mesh sizes: 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.5 inch square mesh. For summary purposes the various species of fish were grouped into 3 types: (1) commercial fish (2) game fish and (3) other fish. The more valuable commercial fishes were caught at higher rates in the larger mesh sizes. Game fish were caught at higher rates in the smaller mesh sizes. Data are presented on the frequency distributions of the catches per net day which should give a somewhat better idea of the potential of the various mesh sizes of flag gill nets when fished under commercial conditions than the mean catches. The size of fish available to be caught had in many instances a definite effect on the mean length of the fish caught by the various mesh sizes of flag gill nets. The catch of fish by the flag gill nets for the period March through May was compared with the catch for the period June through August and the catch for shallow sets was compared with the catch for deep sets. In order to determine the selectivity of flag gill nets, the relative composition of the flag gill net catches was compared to estimates of the relative composition of the fish population made by rotenone poisoning. Commercial fish and other fish were much more relatively abundant in the flag gill net samples while game fish were considerably more relatively abundant in the samples taken by rotenone poisoning. Attempts have been made to close Lake Bistineau to all commercial fishing. I doubt that either restricting or allowing commercial fishing on Lake Bistineau will have much affect on the fish population. Nevertheless commercial fishing should be allowed since it utilizes a resource that would otherwise be wasted. I would recommend a minimum legal size of 3.0 inch square mesh for gill nets fished in Lake Bistineau based on 2 considerations: (1) the catch of game fish in the various mesh sizes and (2) characteristics of the commercial fishery.

Introduction

A considerable number of complaints were received by the Louisiana Wild Life and Fisheries Commission relative to illegal catches of game fishes by flag gill nets in Lake Bistineau. It is illegal to keep any game fish caught in commercial gear in Louisiana. At the time of the investigation it was legal to fish commercial flag gill nets of 2.0 inches square mesh and larger. In order to determine the efficiency and selectivity of flag gill nets in catching fish, experimental flag gill nets were fished in Lake Bistineau during the period from March through August, 1956.

I am indebted to the many employees of the Louisiana Wild Life and Fisheries Commission who assisted in the collection and analysis of the data. Acknowledgment is made to Dr. Jess Muncy, Louisiana State University, for his criticisms and suggestions on an earlier draft of the manuscript. This report is a contribution of Louisiana Federal Aid in Fish Restoration Project F-1-R.

Description of Lake Bistineau

Lake Bistineau, located in northwest Louisiana, is a large impoundment with an area of 17,200 acres. It was created in 1938 by the establishment of a dam across the Bayou Dorcheat bottom. The lake has a mean depth of 7 feet, and the majority of the lake is less than 10 feet deep (Figure 1). The Bayou Dorcheat bottom was not cleared prior to impoundment; however, within a few years after impoundment all of the trees and shrubs except these species which can tolerate permanent flooding were killed; and dead trees, logs, and stumps are numerous in the lake. Extensive stands of species which tolerate considerable flooding (e.g., bald cypress, Taxodium distichum; water elm, Planera aquatica; and swamp privet, Forestiera acuminata) still exist in the lake; however, these plants have been killed to some extent in deeper areas of the lake. Normally the lake is very clear, except during periods of excessive rainfall. Because of this and the relative shallowness of the lake, submergent aquatics (coontail, Ceratophyllum, spp.; blatterwort, Uticularia spp.; najas, Najas spp., etc.) are abundant.

Description of Flag Gill Nets

Flag gill nets are similar to conventional gill nets but differ in several important features. Flag gill nets - as used in Louisiana - have no lead line and are hung on a top line which contains no floats. The net is fished by suspending it in the water from floats at any desired depth. The nets are often fished with the top line on or close to the surface of the water. Practically all commercial gill nets used in Louisiana are of the flag type. Figure 2 shows a flag gill net and illustrates the manner in which it is suspended from floats.

Materials and Methods

Experimental Fishing of Flag Gill Nets

A total of 70 flag gill net sets were made during the period from March through August, 1956. Nets used were 175 yards long and 8 feet deep and consisted of 25 yards of the following mesh sizes: 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.5 inch square mesh. The nets were constructed of nylon thread size number 139 netting hung on number 30 nylon filament twine. The nets were hung on a one-half basis, i.e., 200 feet of netting on 100 feet of top line. For the most part each net set was fished approximately 24 hours and samples were taken at different depths and in all types of habitat occurring in the lake.

The nets were set in a more or less straight line and according to the terminology used by White (1959) relative to types of net sets, the sets would correspond generally to his "fixed set." The nets were anchored or tied to poles in order to held the nets in the same relative position throughout the set.

Analysis of Data

The flag gill net catch data were analyzed so as to determine the effects of different mesh sizes, time of year, and depth of set on the catch. The comparisons of the catch of fish in different mesh sizes were based on 68 flag gill net sets. The catch of 48 flag gill net sets made during the period from March through May was compared with the catch of 22 flag gill net sets made during the period from June through July. The catch of 55 flag gill net sets of less than 6 feet deep was compared with the catch of 9 flag gill net sets of 6 feet of deeper. The depth of the set as used in this report is the depth of the top line of the net in the water. Most of the sets were of less than 6 feet deep, inasmuch as the majority of the lake is not of sufficient depth to make deeper sets.

In order to determine the selectivity of flag gill nets, the composition of the flag gill net catches was compared with estimates

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Figure 1. - Map of Lake Bistineau with cross-sections. (Data for this map was furnished by R. Yancey, Louisiana Wild Life and Fisheries Commission).

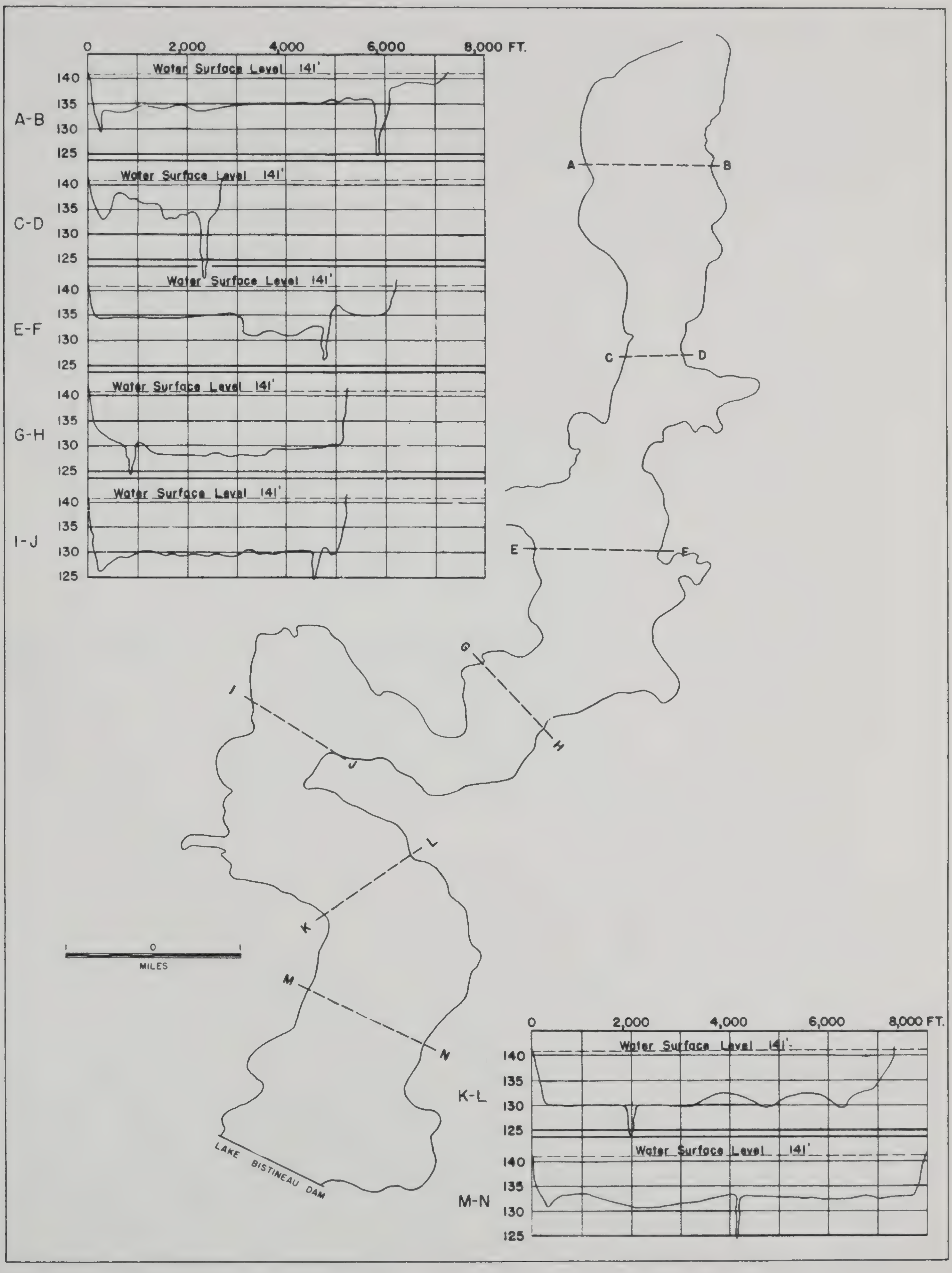
0
2,000
4,000
6,000
8,000 FT.
Water Surface Level 141'
140
135
130
125
A-B
C-D
E-F
G-H
I-J
K-L
M-N
A
B
C
D
E
F
G
H
I
J
K
L
M
N
1
0
1
MILES
LAKE BISTINEAU DAM

Figure 2. - Flag gill net illustrating the manner in which it is suspended from floats.

of the composition of the fish population obtained by rotenone poisoning.

For summary purposes the various species of fish were grouped into 3 types: (1) commercial fish, (2) game fish and (3) other fish. The species of fish considered as commercial, game and other fish are shown in Table 1.

The unit of measurement employed in determining the efficiency of the flag gill nets was the number of fish caught per net day. The abundance of fish on a net day basis was computed for each gill net set and for each mesh size. The number of fish per net day for each set represents the catch for 175 yards of flag gill netting while the number per net day for any mesh size represents the catch for 25 yards of netting.

In some instances, the differences in the catch of different mesh sizes of flag gill nets or different types of sets obviously are significant. However, in other instances it is not clear whether or not the observed differences are due to chance. Therefore, in this study the data were treated statistically in order to determine if the observed differences are significant. The distribution of the number of fish per net day (Table 2) obviously was not normal and therefore the "Normal Theory" was not applied. A transformation to normalize the distributions was not evident, therefore, the chi-square method of analysis was used. In order to compare the efficiency of various mesh sizes or different types of sets in catching a certain species of fish, chi-square was computed as follows:

$$x^2 = \sum \left[\frac{\left(\text{deviations of expected catch from actual catch}\right)^2}{\text{expected catch}} \right]$$

The expected catch for different types of sets (or mesh sizes) being compared is that part of the actual total catch of both types of sets which is directly proportional to the total number of net days fished by each type of set. The formula for chi-square was adjusted for continuity by substracting 0.5 from the absolute values of the deviations.

In order to compare statistically the catch of total fish, commercial fish and game fish, for various mesh sizes or different types of sets, the chi-square method as described by Snedecor (1956) was used. The catch for each species was considered as a sub-sample of the total catch. The chi-square values for the sub-samples were summed. A pooled chi-square was computed for the total catch and a heterogenity or interaction chi-square was calculated by subtracting the pooled chi-square from the sum of the chi-squares. The differences in the total catch of commercial fish and game fish for the various mesh sizes of different types of sets were tested statistically in a manner similar to that for the total catch. The differences in the total catch of other fish were not tested statistically inasmuch as other fish consisted almost entirely of gizzard shad.

The differences in the relative composition of the catch for different mesh sizes or types of sets were tested statistically by the chi-square test of homogenity.

Comparison of the Catch Between Different Mesh Sizes

Catch Rates

There were considerable differences in the catch rates for the various mesh sizes (Table 3). The number of fish caught per net day first increased as the mesh size increased from 1.0 inch. The 2.0 inch mesh had the highest catch rate; however, after that the catch rate decreased and the 4.5 inch mesh size had the lowest catch rate.

Tests of significance of the differences in total catch rates between the mesh sizes are given in Table 4. All of the summed chi-square values, with the exception of the chi-square value for the comparison between the 3.5 and 4.5 inch meshes, were significant. Therefore, the alternate hypothesis that the catch rates of the individual species of fish deviate from the hypothetical catch rate with no distinction being made for excess or deficit in the catch rates is accepted, i.e., except for the comparisons between the 3.5 and 4.5 inch mesh sizes.

All of the heterogenity or interaction chi-square values for the total catch were significant with the exception for the comparisons between the 3.0 and 3.5; and 3.5 and 4.5 inch mesh sizes. The heterogenity chi-square measures the inconsistency of the oscillations above and below the hypothetical catch rate. For the comparisons with significant heterogenity chi-square values, the alternate hypothesis that the catch rates are not consistantly more or less than the hypothetical catch rate is accepted.

The pooled chi-square values for the comparisons between the 1.0 and 1.5; 1.5 and 2.0; 2.0 and 2.5; and the 2.5 and 3.0 inch mesh sizes were significant. However, since the heterogenity chi-square values were also significant, this would indicate that one mesh size did not consistantly catch more or less than the other mesh size it is being compared to, and that the significant differences in the pooled catch are due to the significant

Table 1. - Species of fish considered as commercial, game and other fish. Scientific names are from Bailey, *et al*. (1960).

Common name	Scientific name
Commercial fish:	
Yellow bullhead	*Ictalurus natalis*
Channel catfish	*Ictalurus punctatus*
Blue catfish	*Ictalurus furcatus*
Flathead catfish	*Pylodictis olivaris*
Bowfin	*Amia calva*
Fresh-water drum	*Aplodinotus grunniens*
Spotted gar	*Lepisosteus oculatus*
Shortnose gar	*Lepisosteus platostomus*
Alligator gar	*Lepisosteus spatula*
Longnose gar	*Lepisosteus osseus*
Smallmouth buffalo	*Ictiobus bubalus*
Black buffalo	*Ictiobus niger*
Spotted sucker	*Minytrema melanops*
Lake chubsucker	*Erimyzon sucetta*
River carpsucker	*Carpiodes carpio*
Game fish:	
Largemouth bass	*Micropterus salmoides*
Spotted bass	*Micropterus punctulatus*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Bluegill sunfish	*Lepomis macrochirus*
Redear sunfish	*Lepomis microlophus*
Warmouth sunfish	*Chaenobryttus gulosus*
Longear sunfish	*Lepomis megalotis*
Spotted sunfish	*Lepomis punctatus*
Orangespotted sunfish	*Lepomis humilis*
Bantam sunfish	*Lepomis symmetricus*
Yellow bass	*Roccus mississippiensis*
Chain pickerel	*Esox niger*
Other fish:	
Golden shiner	*Notemigonus crysoleucas*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Pirate perch	*Aphredoderus sayanus*
American eel	*Anguilla rostrata*
Tadpole madtom	*Noturus gyrinus*
Other fishes[1]	

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[1] Includes unidentified fishes and hybrid sunfish.

Table 2. - Total number of fish caught per net day frequency distributions for the various mesh sizes of flag gill nets.

Total number per net day	Mesh size						
	1.0	1.5	2.0	2.5	3.0	3.5	4.5
0	12	3	2	7	31	57	61
>0- 1.9	11	3	2	7	23	8	5
2.0- 3.9	21	10	8	16	10	3	2
4.0- 5.9	12	11	11	15	2	--	--
6.0- 7.9	4	12	9	9	--	--	--
8.0- 9.9	5	2	10	4	1	--	--
10.0-11.9	2	13	7	5	--	--	--
12.0-13.9	--	4	4	1	1	--	--
14.0-15.9	1	3	4	2	--	--	--
16.0-17.9	--	1	3	1	--	--	--
18.0-19.9	--	1	2	--	--	--	--
20.0-21.9	--	2	2	--	--	--	--
22.0-23.9	--	1	--	--	--	--	--
24.0-25.9	--	1	--	--	--	--	--
26.0-27.9	--	--	1	--	--	--	--
28.0-29.9	--	--	--	--	--	--	--
30.0-31.9	--	--	1	--	--	--	--
32.0-33.9	--	--	--	1	--	--	--
34.0-35.9	--	--	--	--	--	--	--
36.0-37.9	--	1	--	--	--	--	--
38.0-39.9	--	--	2	--	--	--	--
Mean	3.35	8.32	9.78	5.22	1.19	0.23	0.13

Table 3. - Number of fish caught per net day in flag gill nets by kinds of fish and mesh size.

	1.0 inch mesh	1.5 inch mesh	2.0 inch mesh	2.5 inch mesh	3.0 inch mesh	3.5 inch mesh	4.5 inch mesh
Total fish	3.35	8.32	9.78	5.22	1.19	0.23	0.13
Commercial fish	1.10	2.19	1.23	0.78	0.26	0.13	0.13
Game fish	2.07	4.38	1.93	0.73	0.27	0.01	0.00
Other fish	0.18	1.74	6.61	3.71	0.66	0.08	0.00

Table 4. - Test of significance of differences in total catch, commercial fish catch, and game fish catch in the various mesh sizes of flag gill nets.

	1.0 and 1.5 inch mesh		1.5 and 2.0 inch mesh		2.0 and 2.5 inch mesh		2.5 and 3.0 inch mesh		3.0 and 3.5 inch mesh		3.5 and 4.5 inch mesh	
	D.F.	x^2	D.F.	x^2	D.F.	x^2	D.F.	x^2	D.F.	x^2	D.F.	x^2
Total fish												
Sum of	26	237.26^3	24	329.18^3	24	154.56^3	24	209.66^3	14	55.92^3	7	13.38
Pooled	1	143.62^3	1	7.98^3	1	94.06^3	1	172.52^3	1	43.92^3	1	1.76
Heterogenity	25	93.64^3	23	321.20^3	23	60.50^3	23	37.14^2	13	12.00	6	11.62
Commercial fish												
Sum of	11	38.20^3	12	35.50^3	13	33.38^3	13	38.41^3	6	6.45	5	6.68
Pooled	1	25.56^3	1	18.49^3	1	6.81^3	1	17.45^3	1	2.94	1	------[1]
Heterogenity	10	12.64	11	17.01	12	26.57^3	12	20.96	5	3.51	4	6.68
Game fish												
Sum of	12	109.93^3	10	95.31^3	9	64.75^3	8	20.72^3	5	19.10^3	--	-----
Pooled	1	56.63^3	1	64.61^3	1	37.15^3	1	14.59^3	1	15.31^3	--	-----
Heterogenity	11	53.30^3	9	30.70^3	8	27.60^3	7	6.13	4	3.79	--	-----

[1] Less than 0.005

[2] Significant at probability of 0.05

[3] Significant at probability of 0.01

differences in the catch rate of a few of the individual species of fish which made up a relatively large portion of the total catch (Table 5). The 3.0 inch mesh consistantly caught more fish than the 3.5 inch mesh (pooled chi-square significant and heterogenity chi-square not significant).

The catch rate for commercial fish was 1.10 fish per net day for the 1.0 inch mesh and increased to 2.19 for the 1.5 inch mesh; however, the catch rate decreased for the larger mesh sizes and 0.13 fish per net day was caught by the 3.5 and 4.5 inch mesh sizes (Table 3).

The sum of the chi-square values for the comparisons between the catch rates of commercial fish for the 1.0 and 1.5; 1.5 and 2.0; 2.0 and 2.5; and 2.5 and 3.0 were significant showing that there were differences in the catch rates for individual species of commercial fish (Table 4). The heterogenity chi-square values for the comparisons between the 1.0 and 1.5; 1.5 and 2.0 and the 2.5 and 3.0 inch mesh nets were not significant. Therefore, it is assumed that there were differences in total catch rate of commercial fish and in general the differences in the catch rates for the individual species of commercial fish for the comparisons between the various mesh sizes are in the same direction.

The heterogenity and the pooled chi-square value for the comparison between the catch rate of commercial fish in the 2.0 and 2.5 inch mesh sizes were both significant. Therefore, the catch rates for the individual species were not consistantly more or less for either mesh size and differences in the pooled catch are due to differences in the catch rates of a few species of fish which make up a relatively large portion of the total catch.

No significant differences were found in the catch rates of commercial fish between the 3.0 and 3.5; and 3.5 and 4.5 inch mesh sizes.

Even though the catch rates for commercial fish were the highest for the 1.5 inch mesh size, the catch rate for the more valuable commercial fishes were higher for the larger mesh sizes (Table 5). Smallmouth and black buffalo had the highest catch rates in the 4.5 inch mesh size while channel catfish had the highest catch rate in the 2.5 inch mesh size. The catch rates for flathead catfish were the highest for the 3.0 and 3.5 inch mesh sizes. However, no significant differences could be demonstrated in the catch rates in the various mesh sizes for the above species of commercial fishes. Species which were of much less value commercially, such as yellow bullhead, spotted gar, shortnose gar, alligator gar, longnose gar and lake chubsucker, had the highest catch rates in the 1.5 inch mesh size.

The 1.0 inch mesh size had a catch rate of 2.07 game fish per net day (Table 3). The catch rate increased to 4.38 for the 1.5 inch mesh size. The catch rate then decreased for the larger mesh sizes and 1.93, 0.73 and 0.27 game fish per net day were caught in the 2.0, 2.5 and 3.0 inch mesh sizes respectively. Only 0.01 game fish per net day were caught by the 3.5 inch mesh size and no game fish were caught by the 4.5 inch mesh size.

The summed chi-square values, as well as the pooled and heterogenity chi-square values, were all significant for the comparisons between the catch rates of game fish in the 1.0 and 1.5, 1.5 and 2.0, 2.0 and 2.5 inch mesh sizes (Table 4). This would indicate that there were significant differences in the catch rates between the various mesh sizes but that the catch rates for the individual species of game fish were not consistantly more or less for any of the above mesh sizes. The differences in the total catch rates of game fish were due mainly to differences in the catch rates of those species of game fish which made up a relatively large portion of the total catch.

The summed chi-square values and the pooled chi-square values for the comparisons between the catch rates of game fish for the 2.5 and 3.0 and 3.0 and 3.5 inch mesh sizes were significant. The heterogenity chi-square values were not significant. This would indicate that there were significant differences in the catch rates of game fishes and that the differences in the catch rates for the individual species of game fish were generally in the same direction. The 3.0 inch mesh size caught less than the 2.5 inch mesh size and the 3.5 inch mesh size caught less than the 3.0 inch mesh size.

Most of the various species of sunfishes (bluegill, redear, warmouth and orangespotted sunfish) had the highest catch rates in the 1.5 inch mesh size (Table 5). However, longear and spotted sunfish, which usually are of a smaller average size than other species of sunfish were caught only by the 1.0 inch mesh size. Orangespotted sunfish which also are usually of a small average size were caught only by the 1.5 inch mesh size; however, the difference between the catch rate for the 1.0 and 1.5 inch mesh sizes was not significant.

Largemouth and spotted bass were caught at the highest rate in the 1.5 and 2.0 inch mesh sizes; however, the catch rates were low for all mesh sizes and most of the differences in the catch rates among the various mesh sizes were not significant.

Table 5. - Number of fish caught per net day in flag gill nets by species of fish and mesh sizes.

	Number per net day 1.0" mesh	Chi-sq. for 1.0"and 1.5"mesh	Number per net day 1.5" mesh	Chi-sq. for 1.5"and 2.0"mesh	Number per net day 2.0" mesh	Chi-sq. for 2.0"and 2.5"mesh	Number per net day 2.5" mesh	Chi-sq. for 2.5"and 3.0"mesh	Number per net day 3.0" mesh	Chi-sq. for 3.0"and 3.5"mesh	Number per net day 3.5" mesh	Chi-sq. for 3.5"and 4.0"mesh	Number per net day 4.5" mesh
Yellow bullhead	0.09	5.06[2]	0.27	4.32[2]	0.10	0.90	0.04	1.33	----	----	----	----	----
Channel catfish	----	----[1]	0.01	----[1]	0.01	0.25	0.04	1.33	----	----	----	----	----
Blue catfish	----	----	----	----	----	----[1]	0.01	----[1]	----	----	----	----	----
Flathead catfish	0.03	----[1]	0.01	----[1]	----	0.73	0.03	----[1]	0.04	----[1]	0.04	1.33	----
Bowfin	----	----[1]	0.01	----[1]	----	0.50	0.03	0.50	----	----	----	----	----
Fresh-water drum	----	----	----	1.33	0.04	----[1]	0.03	0.31	0.06	----[1]	0.04	0.25	0.01
Spotted gar	0.17	12.53[3]	0.55	3.56	0.33	11.20[3]	0.06	2.25	----	----	----	----	----
Shortnose gar	0.09	0.14	0.12	0.61	0.07	----[1]	0.06	----[1]	0.04	1.07	----	----	----
Alligator gar	----	0.50	0.03	0.50	----	----[1]	0.01	----[1]	----	----	----	----	----
Longnose gar	0.69	1.86	0.91	11.72[3]	0.42	8.38[3]	0.14	0.96	0.07	1.35	0.01	----[1]	0.03
Smallmouth buffalo	----	----	----	----	----	----[1]	0.01	----[1]	0.03	----[1]	0.03	0.62	0.08
Black buffalo	----	----	----	----	----	----	----	----	----	----	----	----[1]	0.01
Spotted sucker	0.04	3.89[2]	0.16	0.80	0.25	0.18	0.30	18.35[3]	----	----	----	----	----
Lake chubsucker	----	4.07[2]	0.09	2.20	0.01	----[1]	----	----[1]	0.01	----[1]	----	----	----
River carpsucker	----	----[1]	0.01	----[1]	----	----	----	----	----	----	----	----	----
Largemouth bass	0.05	5.91[2]	0.23	----[1]	0.21	1.06	0.12	1.70	0.04	1.33	----	----	----
Spotted bass	0.01	----[1]	0.03	----[1]	0.03	----[1]	0.01	----[1]	----	----	----	----	----
White crappie	0.01	----[1]	0.01	0.74	0.06	0.04	0.08	0.26	0.04	1.33	----	----	----
Black crappie	0.22	0.27	0.28	0.13	0.33	0.01	0.35	3.92[2]	0.16	9.19[3]	----	----	----
Bluegill sunfish	0.63	4.77[2]	0.98	18.29[3]	0.36	15.58[3]	0.04	1.24	----	----[1]	0.01	----[1]	----
Redear sunfish	0.21	27.82[3]	0.90	7.29[3]	0.50	26.50[3]	0.03	0.50	----	----	----	----	----
Warmouth sunfish	0.28	----[1]	0.30	15.52[3]	0.03	0.50	----	----	----	----	----	----	----
Longear sunfish	0.03	0.36	----	----	----	----	----	----	----	----	----	----	----
Spotted sunfish	0.09	4.07[2]	----	----	----	----	----	----	----	----	----	----	----
Orangespotted sunfish	----	0.29	0.03	0.29	----	----	----	----	----	----	----	----	----
Yellow bass	0.23	56.33[3]	1.40	37.54[3]	0.35	11.87[3]	0.09	4.17[2]	----	----	----	----	----
Chain pickerel	0.30	0.38	0.23	9.30[3]	0.03	0.50	----	----[1]	0.01	----[1]	----	----	----
Golden shiner	0.01	----[1]	----	----	----	----	----	----	----	----	----	----	----
Gizzard shad	0.15	84.68[3]	1.68	196.52[3]	6.58	53.88[3]	3.71	147.21[3]	0.63	29.96[3]	0.08	3.88[2]	----
Threadfin shad	----	----	----	----	----	----	----	----[1]	0.01	----[1]	----	----	----
Other fishes	0.01	0.80	0.06	0.17	0.03	0.50	----	----[1]	0.01	----[1]	----	----	----

[1] Less than 0.005

[2] Significant at probability of 0.05 with 1 degree of freedom

[3] Significant at probability of 0.01 with 1 degree of freedom

Both the black and white crappie had the highest catch rates in the 2.5 inch mesh size. The catch rates for crappie decreased rapidly for the larger mesh sizes.

The catch rate for yellow bass was by far the highest in the 1.5 inch mesh size (1.40 yellow bass per net day). The 1.0, 2.0 and 2.5 inch mesh sizes caught yellow bass at the rate of 0.23, 0.39 and 0.09 fish per net day respectively. All of the above differences in catch rates were significant. No yellow bass were caught in the larger mesh sizes.

The only other fish (*i.e.*, other than commercial or game fish) which were caught in any abundance were gizzard shad. The 1.0 inch mesh size caught 0.15 gizzard shad per net day, and this increased to 1.68 and 6.58 for the 1.5 and 2.0 inch mesh sizes, respectively. The catch rates then decreased rapidly for the larger mesh sizes and 3.71, 0.63 and 0.08 gizzard shad per net day were caught in the 2.5, 3.0 and 3.5 inch mesh sizes. No gizzard shad were caught in the 4.5 inch mesh size. All the differences in the catch rates of gizzard shad were significant.

Number per Net Day Frequencies

It is probable that the mean catch per net day of flag gill nets fished experimentally is not a good measure of what commercial fishermen would catch using the same types of nets. In the experimental fishing of flag gill nets, an attempt was made to make sets at different depths and in all types of habitat in the lake. In other words, an attempt was made to randomize the flag gill net sets as to depth, location on the lake, type of habitat and other variables. A commercial fisherman would not do this. Through experience he should know which are the most productive sets for the fishes he wishes to catch and would only make such sets. Therefore, it is expected that the commercial fishermen would make more sets which caught the desired commercial fish at higher catch rates and less sets with the lower catch rates. Therefore, his average catch should be more than the experimental sets. By the same line of reasoning it is expected that the commercial fisherman could have some influence over the selectivity of the nets he fishes.

The frequency distributions of the catches per net day should give a somewhat better idea of the potential of the various mesh sizes of flag gill nets in catching various species of fish when fished under commercial conditions than the mean catches. The frequency of the catches per net day, by species of fish, for the various mesh sizes are given in Table 6 through 12.

For the most part, considering each species of fish seperately, a species was not represented in the catch of a majority of the individual flag gill net sets. This does not mean that a majority of the sets caught no fish at all, *e.g.*, if a set caught no bluegill sunfish it might have caught some gizzard shad. The above situation was true for all mesh sizes with four exceptions. For the 1.5 inch mesh size, only 34 our of 68 sets caught no longnose gar and only 30 sets caught no gizzard shad. Only 10 sets for the 2.0 inch mesh size and 17 sets for the 2.5 inch mesh size caught no gizzard shad.

The catch rates for the 1.0 inch mesh size were not widely distributed (Table 6). The mode for the catch rates of all species occurred at the 0 fish per net day class and very few species were caught at a rate exceeding 3.9 fish per net day. Only one set caught a species (bluegill sunfish) at a rate of approximately 9.0 fish per net day.

The catch rates for the 1.5 inch mesh size had a much wider distribution (Table 7). The mode for the catch rates of all species occurred at the 0 fish per net day class. For most species the catch rates for any individual set did not exceed 3.9 fish per net day. A few species were caught at rates for in sets up to 9.9 fish per net day. Only three species were caught at catch rates above 9.9 fish per net day. The distribution of the catch rates for yellow bass was most interesting. A catch rate for yellow bass of approximately 9.0 fish per net day occurred only twice, and at no time were yellow bass caught at rates from 10.0 through 29.9 fish per net day. However, one set caught yellow bass at a rate of approximately 40.0 fish per net day.

The catch rates for the 2.0 inch mesh size were not as widely distributed as for the 1.5 inch mesh size, *i.e.*, with the exception of the catch rates for 1 species - gizzard shad (Table 8). The majority of the catch rates for gizzard shad were less than 21.9 fish per net day; however, in 2 instances gizzard shad were caught at rates between 34.0 and 38.0 fish per net day. For most species, other than gizzard shad, the catch rates for any individual set did not exceed 3.9 fish per net day.

As with the 2.0 inch mesh size, the catch rates for the 2.5 inch mesh size were not widely distributed with the exception of the rates for gizzard shad (Table 9). The mode for the catch rates for all species was at the 0 fish per net day class. For most species, the catch rates for any individual set did not exceed 3.9 fish per net day, *i.e.*, with the exception of gizzard shad. Gizzard shad were caught at a rate up to approximately 21.0 fish per net day for

Table 6. - Number of fish per net day frequency distributions for 1.0 inch mesh flag gill nets.

	Number per net day						
	0	>0- 1.9	2.0- 3.9	4.0- 5.9	6.0- 7.9	8.0- 9.9	Mean
Yellow bullhead	63	5	--	--	--	--	0.09
Channel catfish	68	--	--	--	--	--	----
Blue catfish	68	--	--	--	--	--	----
Flathead catfish	67	1	--	--	--	--	0.03
Bowfin	68	--	--	--	--	--	----
Fresh-water drum	68	--	--	--	--	--	----
Spotted gar	59	8	1	--	--	--	0.17
Shortnose gar	65	2	--	1	--	--	0.09
Alligator gar	68	--	--	--	--	--	----
Longnose gar	40	17	10	--	1	--	0.69
Smallmouth buffalo	68	--	--	--	--	--	----
Black buffalo	68	--	--	--	--	--	----
Spotted sucker	66	2	--	--	--	--	0.04
Lake chubsucker	68	--	--	--	--	--	----
River Carpsucker	68	--	--	--	--	--	----
Largemouth bass	65	3	--	--	--	--	0.05
Spotted bass	67	1	--	--	--	--	0.01
White crappie	67	1	--	--	--	--	0.01
Black crappie	57	9	2	--	--	--	0.22
Bluegill sunfish	46	15	5	1	--	1	0.63
Redear sunfish	58	7	3	--	--	--	0.21
Warmouth sunfish	56	10	1	1	--	--	0.28
Longear sunfish	67	1	--	--	--	--	0.03
Spotted sunfish	64	3	1	--	--	--	0.09
Orangespotted sunfish	68	--	--	--	--	--	----
Yellow bass	58	7	3	--	--	--	0.23
Chain pickerel	58	4	5	1	--	--	0.30
Other fishes	67	1	--	--	--	--	0.01

Table 7. - Number of fish per net day frequency distributions for 1.5 inch mesh flag gill nets.

		Number per net day																
	0	>0- 1.9	2.0- 3.9	4.0- 5.9	6.0- 7.9	8.0- 9.9	10.0- 11.9	12.0- 13.9	14.0- 15.9	16.0- 17.9	18.0- 19.9	20.0- 21.9	22.0- 23.9	24.0- 25.9	26.0- 27.9	28.0- 29.9	30.0- 31.9	Mean
Yellow bullhead	63	3	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	0.27
Channel catfish	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Blue catfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flathead catfish	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Bowfin	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Fresh-water drum	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted gar	47	15	5	--	--	1	--	--	--	--	--	--	--	--	--	--	--	0.55
Shortnose gar	64	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.12
Alligator gar	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
Longnose gar	34	21	10	3	--	--	--	--	--	--	--	--	--	--	--	--	--	0.91
Smallmouth buffalo	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Black buffalo	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sucker	58	9	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.16
Lake chubsucker	64	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.09
River carpsucker	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Largemouth bass	56	9	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.23
Spotted bass	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
White crappie	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Black crappie	59	6	2	--	1	--	--	--	--	--	--	--	--	--	--	--	--	0.28
Bluegill sunfish	38	17	10	2	--	--	--	--	1	--	--	--	--	--	--	--	--	0.98
Redear sunfish	40	14	8	4	2	--	--	--	--	--	--	--	--	--	--	--	--	0.90
Warmouth sunfish	59	4	4	--	1	--	--	--	--	--	--	--	--	--	--	--	--	0.30
Longear sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Orangespotted sunfish	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
Yellow bass	41	13	9	1	1	2	--	--	--	--	--	--	--	--	--	--	1	1.40
Chain pickerel	56	11	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	0.23
Golden shiner	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gizzard shad	30	16	12	5	3	1	--	--	--	--	1	--	--	--	--	--	--	1.68
Threadfin shad	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other fishes	65	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06

Table 8. - Number of fish per net day frequency distributions for 2.0 inch mesh flag gill nets.

	Number per net day																				
	0	>0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.9	10.0-11.9	12.0-13.9	14.0-15.9	16.0-17.9	18.0-19.9	20.0-21.9	22.0-23.9	24.0-25.9	26.0-27.9	28.0-29.9	30.0-31.9	32.0-33.9	34.0-35.9	36.0-37.9	Mean
Yellow bullhead	62	5	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10
Channel catfish	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Blue catfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flathead catfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bowfin	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fresh-water drum	65	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.04
Spotted gar	51	12	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.33
Shortnose gar	63	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.07
Alligator gar	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Longnose gar	50	11	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.42
Smallmouth buffalo	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Black buffalo	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sucker	57	9	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25
Lake chubsucker	67	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
River carpsucker	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	00
Largemouth bass	59	6	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.21
Spotted bass	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
White crappie	64	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06
Black crappie	51	15	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.33
Bluegill sunfish	58	3	3	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.36
Redear sunfish	45	14	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50
Warmouth sunfish	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
Longear sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Orangespotted sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yellow bass	55	9	3	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	0.39
Chain pickerel	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03
Golden shiner	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gizzard shad	10	9	11	12	7	4	--	3	5	2	2	1	--	--	--	--	--	--	1	1	6.58
Threadfin shad	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other fishes	66	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03

Table 9. - Number of fish per net day frequency distributions for 2.5 inch mesh flag gill nets.

	Number per net day												
	0	>0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.9	10.0-11.9	12.0-13.9	14.0-15.9	16.0-17.9	18.0-19.9	20.0-21.9	Mean
Yellow bullhead	65	3	--	--	--	--	--	--	--	--	--	--	0.04
Channel catfish	65	3	--	--	--	--	--	--	--	--	--	--	0.04
Blue catfish	67	1	--	--	--	--	--	--	--	--	--	--	0.01
Flathead catfish	66	2	--	--	--	--	--	--	--	--	--	--	0.03
Bowfin	67	--	1	--	--	--	--	--	--	--	--	--	0.03
Fresh-water drum	66	2	--	--	--	--	--	--	--	--	--	--	0.03
Spotted gar	65	2	1	--	--	--	--	--	--	--	--	--	0.06
Shortnose gar	66	1	1	--	--	--	--	--	--	--	--	--	0.06
Alligator gar	67	1	--	--	--	--	--	--	--	--	--	--	0.01
Longnose gar	59	8	1	--	--	--	--	--	--	--	--	--	0.14
Smallmouth buffalo	67	1	--	--	--	--	--	--	--	--	--	--	0.01
Black buffalo	68	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sucker	54	9	5	--	--	--	--	--	--	--	--	--	0.30
Lake chubsucker	68	--	--	--	--	--	--	--	--	--	--	--	--
River carpsucker	68	--	--	--	--	--	--	--	--	--	--	--	--
Largemouth bass	61	7	--	--	--	--	--	--	--	--	--	--	0.12
Spotted bass	67	1	--	--	--	--	--	--	--	--	--	--	0.01
White crappie	63	4	1	--	--	--	--	--	--	--	--	--	0.08
Black crappie	51	12	5	--	--	--	--	--	--	--	--	--	0.35
Bluegill sunfish	65	3	--	--	--	--	--	--	--	--	--	--	0.04
Redear sunfish	66	2	--	--	--	--	--	--	--	--	--	--	0.03
Warmouth sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--
Longear sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--
Orangespotted sunfish	68	--	--	--	--	--	--	--	--	--	--	--	--
Yellow bass	66	1	--	1	--	--	--	--	--	--	--	--	0.09
Chain pickerel	68	--	--	--	--	--	--	--	--	--	--	--	--
Golden shiner	68	--	--	--	--	--	--	--	--	--	--	--	--
Gizzard shad	17	10	10	15	9	1	2	3	--	--	--	1	3.71
Threadfin shad	68	--	--	--	--	--	--	--	--	--	--	--	--
Other fishes	68	--	--	--	--	--	--	--	--	--	--	--	--

Table 10. - Number of fish per net day frequency distributions for 3.0 inch mesh flag gill nets.

	Number per net day							
	0	>0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.9	10.0-11.9	Mean
Yellow bullhead	68	--	--	--	--	--	--	----
Channel catfish	68	--	--	--	--	--	--	----
Blue catfish	68	--	--	--	--	--	--	----
Flathead catfish	65	--	1	1	1	--	--	0.04
Bowfin	68	--	--	--	--	--	--	----
Fresh-water drum	63	5	--	--	--	--	--	0.06
Spotted gar	68	--	--	--	--	--	--	----
Shortnose gar	66	2	--	--	--	--	--	0.04
Alligator gar	68	--	--	--	--	--	--	----
Longnose gar	63	4	--	--	--	1	--	0.07
Smallmouth buffalo	66	2	--	--	--	--	--	0.03
Black buffalo	68	--	--	--	--	--	--	----
Spotted sucker	68	--	--	--	--	--	--	----
Lake chubsucker	67	1	--	--	--	--	--	0.01
River carpsucker	68	--	--	--	--	--	--	----
Largemouth bass	65	3	--	--	--	--	--	0.04
Spotted bass	68	--	--	--	--	--	--	----
White crappie	65	3	--	--	--	--	--	0.04
Black crappie	64	3	1	--	--	--	--	0.16
Bluegill sunfish	68	--	--	--	--	--	--	----
Redear sunfish	68	--	--	--	--	--	--	----
Warmouth sunfish	68	--	--	--	--	--	--	----
Longear sunfish	68	--	--	--	--	--	--	----
Spotted sunfish	68	--	--	--	--	--	--	----
Orangespotted sunfish	68	--	--	--	--	--	--	----
Yellow bass	68	--	--	--	--	--	--	----
Chain pickerel	67	1	--	--	--	--	--	0.01
Golden shiner	68	--	--	--	--	--	--	----
Gizzard shad	50	11	5	--	--	1	1	0.63
Threadfin shad	67	1	--	--	--	--	--	0.01
Other fishes	67	1	--	--	--	--	--	0.01

Table 11. - Number of fish per net day frequency distributions for 3.5 inch mesh flag gill nets.

	Number per net day				
	0	>0-1.9	2.0-3.9	4.0-5.9	Mean
Yellow bullhead	68	---	---	---	----
Channel catfish	68	---	---	---	----
Blue catfish	68	---	---	---	----
Flathead catfish	65	3	---	---	0.04
Bowfin	68	---	---	---	----
Fresh-water drum	66	1	1	---	0.04
Spotted gar	68	---	---	---	----
Shortnose gar	68	---	---	---	----
Alligator gar	68	---	---	---	----
Longnose gar	67	1	---	---	0.01
Smallmouth buffalo	66	2	---	---	0.03
Black buffalo	68	---	---	---	----
Spotted sucker	68	---	---	---	----
Lake chubsucker	68	---	---	---	----
River carpsucker	68	---	---	---	----
Largemouth bass	68	---	---	---	----
Spotted bass	68	---	---	---	----
White crappie	68	---	---	---	----
Black crappie	68	---	---	---	----
Bluegill sunfish	67	1	---	---	0.01
Redear sunfish	68	---	---	---	----
Warmouth sunfish	68	---	---	---	----
Longear sunfish	68	---	---	---	----
Spotted sunfish	68	---	---	---	----
Orangespotted sunfish	68	---	---	---	----
Yellow bass	68	---	---	---	----
Chain pickerel	68	---	---	---	----
Golden shiner	68	---	---	---	----
Gizzard shad	64	3	1	---	0.08
Threadfin shad	68	---	---	---	----
Other fishes	68	---	---	---	----

Table 12. - Number of fish per net day frequency distributions for 4.5 inch mesh flag gill nets.

	Number per net day			
	0	>0- 1.9	2.0- 3.9	Mean
Yellow bullhead	68	--	--	----
Channel catfish	68	--	--	----
Blue catfish	68	--	--	----
Flathead catfish	68	--	--	----
Bowfin	68	--	--	----
Fresh-water drum	67	1	--	0.01
Spotted gar	68	--	--	----
Shortnose gar	68	--	--	----
Alligator gar	68	--	--	----
Longnose gar	66	2	--	0.03
Smallmouth buffalo	63	5	--	0.08
Black buffalo	67	1	--	0.01
Spotted sucker	68	--	--	----
Lake chubsucker	68	--	--	----
River carpsucker	68	--	--	----
Largemouth bass	68	--	--	----
Spotted bass	68	--	--	----
White crappie	68	--	--	----
Black crappie	68	--	--	----
Bluegill sunfish	68	--	--	----
Redear sunfish	66	--	--	----
Warmouth sunfish	68	--	--	----
Longear sunfish	68	--	--	----
Spotted sunfish	68	--	--	----
Orangespotted sunfish	68	--	--	----
Yellow bass	68	--	--	----
Chain pickerel	68	--	--	----
Golden shiner	68	--	--	----
Gizzard shad	68	--	--	----
Threadfin shad	68	--	--	----
Other fishes	68	--	--	----

an individual set.

The catch rates for all species in the 3.0 inch mesh size were not widely distributed (Table 10). The mode for the catch rates for all species was at the 0 fish per net day class. Only three species of fish had catch rates more than 3.9 fish per net day for individual sets. Flathead catfish, longnose gar, and gizzard shad had catch rates up to 7.9, 9.9 and 11.9 fish per net day for individual sets, respectively.

The catch rates for the 3.5 inch mesh size were much less widely distributed (Table 11). The mode for the catch rates for all species was at the 0 fish per net day class. No species had catch rates higher than 3.9 fish per net day for individual sets.

The catch rates for the 4.5 inch mesh size were extremely narrowly distributed (Table 12). The mode for the catch rates for all species was at the 0 fish per net day class. No species had catch rates higher than 1.9 fish per net day for individual sets.

Relative Composition

There were considerable differences in the relative composition of the catch among the various mesh sizes (Table 13). Commercial fish comprised approximately 33 percent of the total number of fish caught by the 1.0 inch mesh size. The relative composition of commercial fish then decreased as the mesh size became larger to the 2.0 inch mesh size where they comprised 13 percent of the total number. The relative composition of commercial fish then slightly increased for the 2.5 inch mesh size and then rapidly increased for the larger mesh sizes. Commercial fish comprised 100 percent of the total number caught by the 4.5 inch mesh size.

Game fish comprised 62 percent of the total number caught by the 1.0 inch mesh size. The relative composition decreased as the mesh size became larger to where they comprised only 14 percent of the total number caught by the 2.5 inch mesh size. However, the relative composition increased to 22 percent for the 3.0 inch mesh size. It then decreased to 6 percent for the 3.5 inch mesh size and no game fish were caught by the 4.5 inch mesh size.

Only 5.5 percent of the total number caught by the 1.0 inch mesh size consisted of the other fish category. The other fish category consisted almost entirely of gizzard shad. This was true for all mesh sizes. The relative importance of other fish increased as the mesh size became larger and they comprised 71 percent of the total number caught by the 2.5 inch mesh size. The relative composition then decreased and 55 and 36 percent of the total number consisted of other fish in the 3.0 and 3.5 inch mesh sizes, respectively. None were caught in the 4.5 inch mesh size.

Tests of homogenity of proportion of different kinds of fish (commercial, game and other) are given in Table 14. The chi-square values for the comparisons between the 1.0 and 1.5; 1.5 and 2.0; 2.5 and 3.0; 3.0 and 3.5 inch mesh sizes were significant. The chi-square values for the comparisons between the 2.0 and 2.5 and 3.5 and 4.5 inch mesh sizes were not significant. The relative composition of the catches for the 2.0 and 2.5 inch mesh sizes were very similar. Even though there appeared to be considerable differences in the relative composition of the catches by the 3.5 and 4.5 inch mesh size, so few fish were caught by these mesh sizes that their relative composition cannot be compared with any degree of accuracy.

The comparisons of the relative composition of the various species of fish caught by the different mesh sizes are given in Table 15. Tests of homogenity of proportion of different species of fish in the various mesh sizes are given in Table 16. The chi-square values were significant for the comparisons between the 1.0 and 1.5; 1.5 and 2.0; 2.0 and 2.5; and 2.5 and 3.0 inch mesh sizes. They were not significant for the comparisons between the 3.0 and 3.5, and 3.5 and 4.5 inch mesh sizes.

Size of Fish

For the most part, the mean length of the various species of fish caught increased as the mesh size became larger. The mean length of a species caught in a mesh size is a function of the selectivity of the net and the size of fish available to be caught.

Table 17 gives the mean length of fish caught in the various mesh sizes of flag gill nets and the mean lengths of fishes recovered from 18 one acre areas by rotenone poisoning during the late summer and early fall of 1955 (Lambou and Stern, 1957). Also given are: (1) the sample standard deviations when enough fish were measured to justify its calculation and (2) the length ranges. The mean lengths of the fish caught by the flag gill nets were computed from the original data in which measurements were recorded to the nearest one tenth of an inch. However, tables of the length frequency distributions of the various species of fish caught by the flag gill nets were available in which the number of fish were grouped by one half inch size groups, _e.g._, 1.0, 1.5, 2.0 etc. where each group represents the class center of the total length in inches. The population

Table 13. - Percent composition of the various kinds of fish caught in various mesh sizes of flag gill nets, expressed as percent of total number.

	Mesh size						
	1.0 inch	1.5 inch	2.0 inch	2.5 inch	3.0 inch	3.5 inch	4.5 inch
Commercial fish	32.9	26.4	12.6	15.0	22.2	57.3	100.0
Game fish	61.6	52.7	19.8	13.9	22.4	6.4	----
Other fish	5.5	20.9	67.6	71.1	55.4	36.3	----
Total number	228	566	665	355	81	16	9

Table 14. - Test of homogenity of proportion of different kinds of fish in the various mesh sizes of flag gill nets.

	Test of homogenity for					
	1.0 and 1.5 inch mesh	1.5 and 2.0 inch mesh	2.0 and 2.5 inch mesh	2.5 and 3.0 inch mesh	3.0 and 3.5 inch mesh	3.5 and 4.5 inch mesh
Chi-square	28.27[2]	270.15[2]	5.83	7.51[1]	8.49[1]	5.33
Degrees of freedom	2	2	2	2	2	2

---

[1] Significant at probability of 0.05

[2] Significant at probability of 0.01

Table 15. - Relative species composition of fish caught by the various mesh sizes of flag gill nets, expressed as percent of total number.

	Mesh size						
	1.0 inch	1.5 inch	2.0 inch	2.5 inch	3.0 inch	3.5 inch	4.5 inch
Yellow bullhead	2.8	3.3	1.1	0.9	---	---	---
Channel catfish	---	0.2	0.2	0.9	---	---	---
Blue catfish	---	---	---	0.3	---	---	---
Flathead catfish	0.7	0.2	---	0.7	3.7	19.1	---
Bowfin	---	0.2	---	0.6	---	---	---
Fresh-water drum	---	---	0.5	0.6	5.4	19.1	11.0
Spotted gar	5.2	6.7	3.3	1.1	---	---	---
Shortnose gar	2.6	1.5	0.7	1.1	3.3	---	---
Alligator gar	---	0.4	---	0.3	---	---	---
Longnose gar	20.4	10.9	4.3	2.7	5.9	6.4	22.0
Smallmouth buffalo	---	---	---	0.3	2.5	12.7	56.0
Black buffalo	---	---	---	---	---	---	11.0
Spotted sucker	1.2	1.9	2.5	5.7	---	---	---
Lake chubsucker	---	1.0	0.2	---	1.2	---	---
River carpsucker	---	0.2	---	---	---	---	---
Largemouth bass	1.6	2.7	2.2	2.4	3.7	---	---
Spotted bass	0.4	0.4	0.3	0.3	---	---	---
White crappie	0.4	0.2	0.6	1.5	3.7	---	---
Black crappie	6.5	3.3	3.3	6.7	13.7	---	---
Bluegill sunfish	18.7	11.7	3.7	0.8	---	6.4	---
Redear sunfish	6.3	10.8	5.1	0.6	---	---	---
Warmouth sunfish	8.5	3.6	0.3	---	---	---	---
Longear sunfish	0.8	---	---	---	---	---	---
Spotted sunfish	2.6	---	---	---	---	---	---
Orangespotted sunfish	---	0.3	---	---	---	---	---
Golden shiner	0.4	---	---	---	---	---	---
Gizzard shad	4.6	20.2	67.3	71.1	53.1	36.3	---
Threadfin shad	---	---	---	---	1.2	---	---
Other fishes	0.4	0.7	0.3	---	1.1	---	---
Total number	228	566	665	355	81	16	9

Table 16. - Test of homogenity of proportion of different species of fish in the various mesh sizes of flag gill nets.

	Test of homogenity for					
	1.0 and 1.5 inch mesh	1.5 and 2.0 inch mesh	2.0 and 2.5 inch mesh	2.5 and 3.0 inch mesh	3.0 and 3.5 inch mesh	3.5 and 4.5 inch mesh
Chi-square	111.33[1]	343.37[1]	66.65[1]	60.92[1]	22.12	12.53
Degrees of freedom	25	23	23	23	13	6

[1] Significant at probability of 0.05

Table 17. - Mean length (total length in inches) of fish caught in the various mesh sizes of flag gill nets and mean length of fish recovered from 18-one acre areas by rotenone poisoning where $\bar{x}$ equals the mean, n equals the number of specimens which were measured, s equals the sample standard deviation and r equals the range. The values of n for bluegill sunfish, redear sunfish, warmouth sunfish and threadfin shad recovered by rotenone are not the actual number of specimens measured. See text for explanation.

	Gill Net Samples							
	1.0 inch	1.5 inch	2.0 inch	2.5 inch	3.0 inch	3.5 inch	4.5 inch	Rotenone Samples
Yellow bullhead								
$\bar{x}$	9.3	12.1	13.6	12.8	---	---	---	3.6
n	6	20	7	3	---	---	---	260
s	3.125	1.949	0.951	---	---	---	---	1.265
r	6.5-14.0	9.5-16.0	12.5-15.0	10.0-15.5	---	---	---	1.5-9.0
Channel catfish								
$\bar{x}$	---	15.8	23.1	19.6	---	---	---	---
n	---	1	1	3	---	---	---	---
r	---	---	---	18.0-20.5	---	---	---	---
Blue catfish								
$\bar{x}$	---	---	---	20.1	---	---	---	---
n	---	---	---	1	---	---	---	---
Flathead catfish								
$\bar{x}$	14.1	11.7	---	19.8	25.1	24.8	---	13.0
n	1	1	---	2	3	3	---	2
r	---	---	---	18.0-21.5	22.5-28.0	22.5-26.0	---	6.5-19.5
Bowfin								
$\bar{x}$	---	22.8	---	25.6	---	---	---	---
n	---	1	---	2	---	---	---	---
r	---	---	---	22.5-29.0	---	---	---	---
Fresh-water drum								
$\bar{x}$	---	---	15.1	17.0	16.8	17.7	22.2	18.3
n	---	---	3	2	5	3	1	10
s	---	---	---	---	2.104	---	---	1.494
r	---	---	11.5-12.0	17.0-17.0	15.5-18.0	17.0-18.0	---	16.0-21.5
Spotted gar								
$\bar{x}$	30.0	23.0	27.1	36.6	---	---	---	22.1
n	10	36	22	4	---	---	---	10
s	4.708	2.513	3.047	---	---	---	---	2.970
r	17.5-33.0	19.0-29.0	17.5-30.5	21.5-36.0	---	---	---	19.5-29.0
Shortnose gar								
$\bar{x}$	24.7	23.8	31.7	39.5	34.6	---	---	22.0
n	6	7	5	4	2	---	---	6
s	9.704	5.758	2.434	---	---	---	---	0.447
r	15.0-39.5	19.5-35.5	29.0-35.0	36.5-42.0	29.5-39.5	---	---	21.5-22.5
Alligator gar								
$\bar{x}$	---	28.0	---	29.0	---	---	---	---
n	---	2	---	1	---	---	---	---
r	---	27.5-28.5	---	---	---	---	---	---
Longnose gar								
$\bar{x}$	34.2	39.1	40.6	39.6	36.4	37.8	46.5	39.3
n	45	59	28	10	5	1	2	4
s	5.792	4.641	6.403	5.662	6.427	---	---	---
r	25.0-51.0	27.0-52.5	34.0-62.5	27.5-47.0	29.5-43.0	---	45.0-48.0	32.0-46.0
Smallmouth buffalo								
$\bar{x}$	---	---	---	22.7	22.4	20.9	21.9	22.3
n	---	---	---	1	2	2	5	11
s	---	---	---	---	---	---	5.141	2.316
r	---	---	---	---	22.0-22.5	20.5-21.5	13.5-27.5	19.0-27.0
Black buffalo								
$\bar{x}$	---	---	---	---	---	---	24.4	---
n	---	---	---	---	---	---	1	---
Spotted sucker								
$\bar{x}$	17.5	17.9	17.6	18.1	---	---	---	---
n	2	11	16	19	---	---	---	---
s	---	1.350	0.879	0.693	---	---	---	---
r	17.0-17.5	15.5-19.5	16.0-18.5	17.0-19.5	---	---	---	---
Lake chubsucker								
$\bar{x}$	---	11.6	11.8	---	8.8	---	---	7.5
n	---	6	1	---	1	---	---	79
s	---	2.871	---	---	---	---	---	1.396
r	---	9.0-17.0	---	---	---	---	---	4.0-15.5
River carpsucker								
$\bar{x}$	---	18.4	---	---	---	---	---	---
n	---	1	---	---	---	---	---	---
Largemouth bass								
$\bar{x}$	11.6	12.8	15.0	17.9	18.6	---	---	5.7
n	3	15	14	7	3	---	---	472
s	---	3.125	2.235	1.842	---	---	---	3.622
r	7.5-18.5	9.5-20.0	13.5-22.0	16.0-21.0	17.0-20.5	---	---	1.5-19.5

Continued on next page

Table 17. - continued

	Gill Net Samples							
	1.0 inch	1.5 inch	2.0 inch	2.5 inch	3.0 inch	3.5 inch	4.5 inch	Rotenone Samples
Spotted bass								
$\bar{x}$	7.9	11.9	14.2	16.1	---	---	---	9.7
n	1	2	2	1	---	---	---	3
r	---	11.5-12.0	14.0-14.5	---	---	---	---	5.0-11.5
White crappie								
$\bar{x}$	6.5	14.9	.13.9	14.3	15.2	---	---	6.3
n	1	1	5	6	3	---	---	3
s	---	---	1.696	0.517	---	---	---	19.0
r	---	---	12.0-16.0	13.5-15.0	15.0-15.5	---	---	2.5-14.0
Black crappie								
$\bar{x}$	6.8	10.2	12.0	13.5	14.2	---	---	4.6
n	14	17	19	22	5	---	---	481
s	2.548	1.947	1.294	0.542	0.629	---	---	2.258
r	5.0-12.5	8.0-14.5	10.5-14.5	12.5-14.5	14.0-15.5	---	---	1.0-13.5
Bluegill sunfish								
$\bar{x}$	5.4	6.8	7.9	8.6	---	7.8	---	2.1
n	40	63	25	3	---	1	---	34,412
s	0.897	0.620	0.564	---	---	---	---	0.969
r	3.5-7.5	5.0-8.0	6.0-8.5	8.0-9.0	---	---	---	1.0-9.0
Redear sunfish								
$\bar{x}$	5.8	7.4	9.1	10.7	---	---	---	2.6
n	13	57	33	2	---	---	---	11,249
s	1.452	0.641	0.695	---	---	---	---	1.239
r	4.5-9.5	6.5-10.0	7.0-10.0	10.5-11.0	---	---	---	1.0-10.0
Warmouth sunfish								
$\bar{x}$	7.3	7.5	8.9	---	---	---	---	1.6
n	18	21	2	---	---	---	---	30,070
s	1.211	0.661	---	---	---	---	---	0.487
r	5.5-9.0	6.0-8.5	8.0-9.5	---	---	---	---	1.0-9.5
Longear sunfish								
$\bar{x}$	4.7	---	---	---	---	---	---	2.5
n	2	---	---	---	---	---	---	34
s	---	---	---	---	---	---	---	0.389
r	4.5-5.0	---	---	---	---	---	---	2.0-3.5
Spotted sunfish								
$\bar{x}$	4.9	---	---	---	---	---	---	2.1
n	6	---	---	---	---	---	---	2,163
s	0.524	---	---	---	---	---	---	0.715
r	4.0-5.5	---	---	---	---	---	---	1.0-5.5
Orangespotted sunfish								
$\bar{x}$	---	7.3	---	---	---	---	---	2.2
n	---	1	---	---	---	---	---	143
s	---	---	---	---	---	---	---	0.645
r	---	---	---	---	---	---	---	1.0-4.0
Yellow bass								
$\bar{x}$	9.5	10.4	11.9	12.8	---	---	---	7.4
n	15	95	23	4	---	---	---	13
s	2.112	1.009	0.762	---	---	---	---	3.587
r	6.5-12.0	8.5-13.0	10.5-14.0	12.0-13.5	---	---	---	2.5-11.5
Chain pickerel								
$\bar{x}$	15.9	18.8	20.0	---	18.6	---	---	9.7
n	18	17	2	---	1	---	---	50
s	2.566	1.463	---	---	---	---	---	5.336
r	13.0-20.5	17.0-22.0	21.5-22.0	---	---	---	---	3.0-21,5
Golden shiner								
$\bar{x}$	7.5	---	---	---	---	---	---	5.5
n	1	---	---	---	---	---	---	1
Gizzard shad								
$\bar{x}$	10.1	13.6	14.3	15.5	15.6	16.1	---	6.8
n	10	111	433	236	42	5	---	1,436
s	3.850	1.793	1.143	0.793	1.179	1.194	---	4.265
r	6.5-15.5	9.5-16.5	12.0-19.0	13.0-19.5	13.5-19.0	14.5-17.5	---	3.0-17.5
Threadfin shad								
$\bar{x}$	---	---	---	---	3.0	---	---	2.4
n	---	---	---	---	1	---	---	147,055
s	---	---	---	---	---	---	---	0.483
r	---	---	---	---	---	---	---	1.0-4.5
Other fishes								
$\bar{x}$	12.7	15.9	14.1	---	9.0	---	---	---
n	1	4	2	---	1	---	---	---

standard deviations and ranges were estimated from the grouped data, inasmuch as the extra labor and time necessary to estimate these parameters from the ungrouped data did not seem justifiable even though such a procedure should be somewhat more efficient.

The estimates of the mean, standard deviations and ranges of the lengths of the fish occurring in the lake as determined by rotenone poisoning were all determined from data where the lengths of the fish were grouped by one half inch size groups (Table 17). The values of n given in Table 17 for bluegill sunfish, redear sunfish, warmouth sunfish and threadfin shad recovered by rotenone poisoning are not the actual number of specimens measured. For these species, the number of specimens recovered from some of the samples for certain of the size groups was so great that it was not justifiable or for that matter it was not possible to count and measure all the specimens. For the samples and size groups where the specimens were not so numerous, all were measured. For the others, sub-samples as large as practical were taken and an estimate made of the number of specimens occurring in that size group for that particular sample. Inasmuch as the sub-samples were more than large enough (at least several thousand were measured in each one half inch size group for each sub-sample) for large sample theory to apply, the estimate of the number occurring in these numerous size groups for each sample was considered as being without error. Actually the values of n for the bluegill sunfish, redear sunfish, warmouth sunfish and threadfin shad are the estimated number occurring in the 18 one-acre rotenone samples.

Sampling fish populations by rotenone poisoning is not extremely selective for any particular size group of fish, i.e., if sufficient attention is given to how the samples are taken (Lambou and Stern, 1958a). Even though the flag gill net samples were not taken during the same period that the fish population was sampled by rotenone poisoning, it is not expected that the size frequencies of fishes occurring in the lake would change drastically enough in less than a year's time so as to completely invalidate any comparisons made. The sampling of the fish population by rotenone poisoning is discussed in more detail in a later section.

By comparing the length frequencies of the fishes caught by the various mesh sizes with those obtained by rotenone poisoning, it was evident that the size of the fish available to be caught had, in many instances, a definite effect on the mean length of the fish caught by the various mesh sizes of flag gill nets. This was especially true for the larger mesh sizes. Due to space limitations it is not possible to give the length frequencies of all the fishes caught by the flag gill nets and recovered by rotenone poisoning, however, these are available in two unpublished reports (Lambou and Stern, 1957 , 1958b). This can also be seen by examining the standard deviations of the lengths (Table 17). For many of these species the standard deviations become less as the mesh size increased. The standard deviation is a measure of dispersion or variability of the size of fish that it is expected can be taken by the various mesh sizes. Surely, we would not expect that the dispersions of the size of fish which a mesh size is capable of catching is less for the larger mesh size than the smaller. The only reasonable conclusion is that in many instances the larger mesh sizes were only catching the smaller size fishes which they are capable of catching and even though they are capable of catching larger size fish, these fish were not available to be caught. To illustrate this, length frequency distributions for gizzard shad are given in Table 18. It can be readily seen that the size of gizzard shad available is affecting the dispersion of the size of fish caught by the larger mesh sizes of flag gill nets.

Comparison of Catch Between Different Times of Year

The catch of fish by flag gill nets for the period March through May was compared with the catch for the period June through August. There were differences in the rates that the flag gill nets caught fish during the 2 periods (Table 19).

The catch rate for total fish was highest during the first period. The summed chi-square values as well as the pooled and heterogenity chi-square values were all significant for the comparisons between the catch rates for the 2 sampling periods (Table 20). This indicates that there were significant differences in the catch rates but that the catch rates for the individual species were not consistantly more or less for either of the 2 periods. The differences in the total catch rates were due mainly to differences in the catch rates of those species which were most abundant.

The catch rate for commercial fish also was highest during the first period. The summed chi-square values as well as the pooled and heterogenity chi-square values were all significant for the comparisons

Table 18. - Length frequency distributions of gizzard shad as determined by flag gill nets and rotenone poisoning expressed as percent of total number.

Total length in inches (class center)	Gill nets - mesh size							
	1.0 inch	1.5 inch	2.0 inch	2.5 inch	3.0 inch	3.5 inch	4.5 inch	Rotenone
1.0 - 2.5	---	---	---	---	---	---	---	---
3.0	---	---	---	---	---	---	---	4.2
3.5	---	---	---	---	---	---	---	13.4
4.0	---	---	---	---	---	---	---	19.4
4.5	---	---	---	---	---	---	---	19.5
5.0	---	---	---	---	---	---	---	11.2
5.5	---	---	---	---	---	---	---	3.7
6.0	---	---	---	---	---	---	---	0.4
6.5	18.2	---	---	---	---	---	---	---
7.0	27.3	---	---	---	---	---	---	0.3
7.5	---	---	---	---	---	---	---	0.1
8.0	---	---	---	---	---	---	---	0.8
8.5	---	---	---	---	---	---	---	0.3
9.0	---	---	---	---	---	---	---	0.8
9.5	---	1.9	---	---	---	---	---	0.4
10.0	9.1	2.8	---	---	---	---	---	1.0
10.5	---	4.7	---	---	---	---	---	1.5
11.0	---	4.7	---	---	---	---	---	0.4
11.5	---	1.9	---	---	---	---	---	1.0
12.0	---	10.3	2.1	---	---	---	---	0.8
12.5	---	4.7	6.5	---	---	---	---	1.3
13.0	---	7.5	8.9	0.4	---	---	---	1.9
13.5	18.2	14.0	16.1	0.4	2.4	---	---	2.8
14.0	---	11.2	14.2	2.1	7.1	---	---	3.8
14.5	9.1	7.5	17.7	9.9	21.4	20.0	---	3.3
15.0	9.1	9.3	14.9	23.2	11.9	---	---	2.9
15.5	9.1	9.3	6.8	26.2	14.3	20.0	---	1.9
16.0	---	5.6	8.4	18.0	14.3	20.0	---	1.6
16.5	---	4.7	2.8	14.6	14.3	---	---	0.9
17.0	---	---	1.2	3.9	4.8	20.0	---	0.2
17.5	---	---	0.2	0.9	7.1	20.0	---	0.1
18.0	---	---	---	---	---	---	---	---
18.5	---	---	---	---	---	---	---	---
19.0	---	---	0.2	---	2.4	---	---	---
19.5	---	---	---	0.4	---	---	---	---
Total number	10	111	433	236	42	5	---	1,436

Table 19. - Number of fish caught per net day in flag gill nets by kinds of fish and time of year.

	Number per net day for March-May	Number per net day for June-August
Total fish	30.06	22.60
Commercial fish	6.46	4.03
Game fish	8.69	10.07
Other fish	14.90	8.50

Table 20. - Test of significance of differences in total catch, commercial fish catch, and game fish catch of flag gill nets during differenct times of the year.

	Degrees of freedom	Chi-square
Total fish		
Sum of	31	195.48[2]
Pooled	1	30.32[2]
Heterogenity	30	165.16[2]
Commercial fish		
Sum of	15	42.78[2]
Pooled	1	15.73[2]
Heterogenity	14	27.05[1]
Game fish		
Sum of	12	104.06[2]
Pooled	1	3.12
Heterogenity	11	100.94[2]

[1] Significant at probability of 0.05

[2] Significant at probability of 0.01

between the catch rates of commercial fish for the 2 periods (Table 20). This indicates that there were significant differences in the catch rates for the individual species but that the catch rates for the individual species of commercial fish were not consistantly more or less for either of the 2 periods. The differences in the total catch rates were due mainly to differences in the catch rates of those species of fish which made up a relatively large portion of the total catch.

Most of the comparisons between the catch rates of the various individual species of commercial fish were not significant (Table 21). The differences between the catch rates of shortnose gar, longnose gar and spotted sucker were significant and all of these species were caught at higher rates during the first sampling period.

Game fish had a higher catch rate during the second sampling period (Table 19). The summed chi-square values as well as the heterogenity chi-square values were significant (Table 20). The pooled chi-square values were not significant. This would indicate that there were significant differences in the catch rates for the individual species of game fish, but that the catch rates were not consistantly more or less for either of the 2 sampling periods. No significant difference could be demonstrated between the total catch rates of game fish.

Most of the comparisons between the catch rates of the various species of game fish were not significant (Table 21). The comparisons between the catch rates of black crappie, bluegill sunfish, warmouth sunfish and yellow bass were significant. Black crappie, bluegill sunfish and warmouth sunfish were caught at higher rates during the second sampling period. The catch rate for yellow bass was considerably higher during the first period.

Gizzard shad were also caught at a considerably higher catch rate during the first sampling period and the difference was significant (Table 21).

There were differences in the relative composition of the catch by flag gill nets during the 2 sampling periods (Table 22). Commercial fish and other fish comprised a relatively larger portion of the total catch during the first sampling period while game fish were relatively more abundant during the second period. A test of homogenity of proportion of different kinds of fish caught during the 2 sampling periods was significant (Table 22). Likewise a test of homogenity of proportion of different species of fish caught during the 2 sampling periods was significant (Table 23).

Comparison of Catch at Different Depths

The catch of fish by flag gill nets set less than 6 feet deep was compared with the catch of nets set 6 feet deep or deeper. There were differences in the catch rates of the flag gill nets set at different depths (Table 24). Total fish, commercial fish, game fish and other fish, all had higher catch rates in the shallow sets.

The summed chi-square values as well as the pooled and heterogenity chi-square values were all significant for the comparison in the catch rate of total fish between the shallow and deep sets (Table 25). This indicates that there were significant differences in the catch rates for the individual species, but that the catch rates were not consistantly more or less for either of the 2 types of sets. The differences in the total catch rates were due mainly to differences in the catch rates of those species which were most abundant.

The catch rate for commercial fish was highest for the shallow sets, however, the summed chi-square values as well as the pooled and heterogenity chi-square values all were not significant. Therefore no differences of any type could be demonstrated between the catch rates of commercial fish in the shallow and deep sets. Only one species of commercial fish (yellow bullhead) had a significant difference in catch rate between the shallow and deep sets (Table 26). Yellow bullhead were caught at a higher rate in the shallow sets.

Game fish were caught at a higher rate in the shallow sets, however, the summed chi-square values as well as the pooled and heterogenity chi-square values were all not significant (Tables 24 and 25). Therefore, no differences of any type could be demonstrated between the catch rates of game fish in the shallow and deep sets. Only 2 species of game fish (redear sunfish and chain pickerel) had significant differences in catch rates between the shallow and deep sets (Table 26). Redear sunfish were caught at a higher rate in the deep sets while chain pickerel were caught at a higher rate in the shallow sets.

Gizzard shad were caught at a higher rate in the shallow sets than in the deep sets, and this difference was significant (Table 26).

There were differences in the relative composition of the catch by gill nets set at different depths; however, a test of homogenity of proportion of different kinds of fish caught at the different depths was not significant (Table 27). A test of homogenity of proportion

Table 21. - Number of fish caught per net day in flag gill nets by species and time of year.

	Number per net day for March-May	Number per net day for June-August	Chi-square
Yellow bullhead	0.45	0.82	3.27
Channel catfish	0.10	---	1.06
Blue catfish	0.02	---	0.17
Flathead catfish	0.12	0.23	0.55
Bowfin	0.06	---	0.30
Fresh-water drum	0.24	0.09	1.01
Spotted gar	1.04	0.98	0.01
Shortnose gar	0.47	0.12	4.17[2]
Alligator gar	0.06	---	0.30
Longnose gar	2.57	1.43	8.31[3]
Smallmouth buffalo	0.19	0.05	1.14
Black buffalo	0.02	---	0.17
Spotted sucker	0.98	0.17	12.62[3]
Lake chubsucker	0.13	0.13	0.09
River carpsucker	0.02	---	0.17
Largemouth bass	0.63	0.66	---[1]
Spotted bass	0.12	---	1.44
White crappie	0.28	0.05	2.96
Black crappie	0.76	2.20	24.53[3]
Bluegill sunfish	1.57	2.93	13.26[3]
Redear sunfish	1.57	1.78	0.28
Warmouth sunfish	0.44	0.94	5.51[2]
Longear sunfish	0.04	---	0.01
Spotted sunfish	0.04	0.18	1.89
Orangespotted sunfish	---	0.08	1.23
Yellow bass	2.77	0.44	38.97[3]
Chain pickerel	0.47	0.81	2.39
Golden shiner	0.02	---	0.17
Gizzard shad	14.71	8.46	45.79[3]
Threadfin shad	0.02	---	0.17
Other fishes	0.15	0.04	0.69

---

[1] Less than 0.005

[2] Significant at probability of 0.05 with one degree of freedom

[3] Significant at probability of 0.01 with one degree of freedom

Table 22. - Percent composition of the various kinds of fish caught by flag gill nets during different times of the year.

	March-May	June-August
Commercial fish	21.5	17.8
Game fish	28.9	44.6
Other fish	49.6	37.6
Total number	14[illegible]	497

Chi-sq. = 41.23; degrees of freedom = 2; significant of probability of 0.01

Table 23. - Relative species composition of fish caught by flag gill nets during different times of year expressed as percent of total number.

	March-May	June-August
Yellow bullhead	1.5	3.6
Channel catfish	0.3	---
Blue catfish	0.1	---
Flathead catfish	0.4	1.0
Bowfin	0.2	---
Fresh-water drum	0.8	0.4
Spotted gar	3.5	4.3
Shortnose gar	1.6	0.5
Alligator gar	0.2	---
Longnose gar	8.5	6.3
Smallmouth buffalo	0.6	0.2
Black buffalo	0.1	---
Spotted sucker	3.3	0.7
Lake chubsucker	0.4	0.6
River carpsucker	0.1	---
Largemouth bass	2.1	2.9
Spotted bass	0.4	---
White crappie	0.9	0.2
Black crappie	2.5	9.8
Bluegill sunfish	5.2	13.0
Redear sunfish	5.2	7.9
Warmouth sunfish	1.5	4.1
Longear sunfish	0.1	---
Spotted sunfish	0.1	0.8
Orangespotted sunfish	---	0.3
Yellow bass	9.2	2.0
Chain pickerel	1.6	3.6
Golden shiner	0.1	---
Gizzard shad	48.9	37.4
Threadfin shad	0.1	---
Other fishes	0.5	0.2
Total number	1443	497

Chi-square = 186.68; degrees of freedom = 30; significant probability of 0.01

Table 24. - Number of fish caught per net day in flag gill nets by kinds of fish and depth of set.

	Number per net day for 0-5.9 feet deep sets	Number per net day for 6.0 feet deep and over sets
Total fish	28.81	23.76
Commercial fish	6.01	4.90
Game fish	8.88	8.59
Other fish	13.92	10.27

Table 25. - Test of significance of differences in total catch, commercial fish catch and game fish catch of flag gill nets set at different depths.

	Degrees of freedom	Chi-square
Total fish		
Sum of	30	55.73[2]
Pooled	1	7.09[2]
Heterogenity	29	48.64[1]
Commercial fish		
Sum of	14	22.35
Pooled	1	1.63
Heterogenity	13	20.72
Game fish		
Sum of	12	18.17
Pooled	1	0.08
Heterogenity	11	18.09

[1] Significant at a probability of 0.05
[2] Significant at a probability of 0.01

Table 26. - Number of fish caught per net day in flag gill nets by species and depth of set.

	Number per net day for 0-5.9 feet deep sets	Number per net day for 6.0 feet deep and over sets	Chi-square
Yellow bullhead	0.69	---	5.12[2]
Channel catfish	0.09	---	0.07
Flathead catfish	0.15	0.11	0.03
Bowfin	0.05	---	0.02
Fresh-water drum	0.15	0.33	0.59
Spotted gar	1.11	0.44	2.79
Shortnose gar	0.41	0.11	1.17
Alligator gar	0.05	---	0.02
Longnose gar	2.31	2.23	---[1]
Smallmouth buffalo	0.11	0.44	3.55
Black buffalo	0.02	---	1.08
Spotted sucker	0.70	1.11	1.20
Lake chubsucker	0.13	0.11	0.16
River carpsucker	0.02	---	1.08
Largemouth bass	0.63	0.22	1.58
Spotted bass	0.09	0.11	0.15
White crappie	0.23	0.11	0.09
Black crappie	1.22	0.80	0.84
Bluegill sunfish	2.11	2.11	0.01
Redear sunfish	1.23	2.33	6.09[2]
Warmouth sunfish	0.65	0.44	0.26
Longear sunfish	0.03	---	0.29
Spotted sunfish	0.09	0.11	0.15
Orangespotted sunfish	0.03	---	0.33
Yellow bass	1.95	2.34	0.41
Chain pickerel	0.63	---	4.54[2]
Golden shiner	---	0.11	1.08
Gizzard shad	13.76	10.16	7.34[3]
Threadfin shad	0.02	---	1.08
Other fishes	0.14	---	0.39

[1] Less than 0.05

[2] Significant at probability of 0.05 with 1 degree of freedom

[3] Significant at probability of 0.01 with 1 degree of freedom

Table 27. - Percent composition of the various kinds of fish caught by flag gill nets set at different depths.

	Sets 0-5.9 feet deep	Sets 6.0 feet and over deep
Commercial fish	20.9	20.6
Game fish	30.8	36.2
Other fish	48.3	43.2
Total number	1585	214

Chi-sq. = 2.72; degrees of freedom = 2; not significant at probability of 0.05.

Table 28. - Relative species composition of fish caught by flag gill nets set at different depths expressed as percent of total number.

	Sets 0-5.9 feet deep	Sets 6.0 feet and over deep
Yellow bullhead	2.4	---
Channel catfish	0.3	---
Blue catfish	---	---
Flathead catfish	0.5	0.5
Bowfin	0.2	---
Fresh-water drum	0.5	1.4
Spotted gar	3.9	1.9
Shortnose gar	1.4	0.5
Alligator gar	0.2	---
Longnose gar	8.0	9.4
Smallmouth buffalo	0.4	1.9
Black buffalo	0.1	---
Spotted sucker	2.4	4.7
Lake chubsucker	0.4	0.5
River carpsucker	0.1	---
Largemouth bass	2.2	0.9
Spotted bass	0.3	0.5
White crappie	0.8	0.5
Black crappie	4.2	3.4
Bluegill sunfish	7.3	8.9
Redear sunfish	4.3	9.8
Warmouth sunfish	2.3	1.9
Longear sunfish	0.1	---
Spotted sunfish	0.3	0.5
Orangespotted sunfish	0.1	---
Yellow bass	6.8	9.9
Chain pickerel	2.2	---
Golden shiner	---	0.5
Gizzard shad	47.8	42.8
Threadfin shad	0.1	---
Other fishes	0.5	---
Total number	1585	214

Chi-sq. = 56.09; degrees of freedom = 29; significant at probability of 0.01

of different species of fish caught at the different depths was significant (Table 28).

Comparison of Flag Gill Net Catches with Fish Population Estimates Obtained by Rotenone Poisoning

In order to determine the selectivity of flag gill nets, the relative composition of the flag gill net catches was compared to estimates of the relative composition of the fish population obtained by rotenone poisoning.

Eighteen areas, each one acre in size, were sampled by rotenone poisoning during August and September of 1955 (Lambou and Stern 1957). Since Lake Bistineau is rather shallow, usually less than 10 feet in depth (Figure 1), it was possible to sample nearly all areas of the lake. All types of habitat were represented in the sampling areas. The sampling areas were surrounded by a 1 inch square mesh net - the "block-off net" described by Lambou (1959a). Three pints of 5 percent emulsifiable rotenone per acre foot of water were applied by pumping the solution through a perforated hose. It was calculated that this would give a concentration of approximately 1 ppm. Fish were recovered over a 2 day period and every possible effort was made to pick up all, including small fish.

Data obtained from rotenone poisoning, or for that matter, data obtained from samples taken with any type of gear, are more or less selective. Rotenone sampling is probably less selective than the other methods. Rotenone sampling, if sufficient attention is given to how the samples are taken, is not extremely selective for any particular kind or size groups of fish. The main inaccuracy associated with this method is that varying percentages of fish occurring in the sampling area are recovered (Lambou and Stern, 1958a). However, all of the samples taken from Lake Bistineau were taken in a similar manner and it is believed thatthe rate of non-recovered fish to recovered fish was of the same magnitude for each sampling area. If this assumption is correct, the rotenone sampling data should furnish an unbiased index to the species composition and abundance of fish in Lake Bistineau. The method of taking rotenone samples in Louisiana and the factors affecting the results, are more fully discussed by Lambou and Stern (1958a).

The data obtained by rotenone poisoning are probably fairly representative of the fish population occurring in Lake Bistineau - in any case, these data are probably much more representative of the fish population than the data obtained from the flag gill net samples.

As stated in a previous section, even though the flag gill net samples were not taken during the same period that the fish population was sampled by rotenone poisoning, I do not believe that the size frequencies (or the population structure) of fishes in the lake would change drastically enough in less than a year's time so as to completely invalidate any comparisons made.

It should be realized that there is considerable overlaping of the sizes of fishes that can be caught by the various mesh sizes of flag gill nets. These relationships are complex and probably vary considerably among the various species of fish. These relationships are not evident enough in the data presented in this report to be described with any degree of accuracy. It is probable that the various sizes of the species of fish were sampled by the flag gill nets at different intensities. However, I do not believe that this is serious enough to completely invalidate any comparisons made with the data obtained by rotenone poisoning. However, I believe the reader should keep in mind the possible biases present when considering the comparisons contained in this section.

Many of the fish occurring in the fish population were of a size too small to be caught by the flag gill nets. Those fish obtained by rotenone poisoning which were considered to be of a size too small to be caught by flag gill nets were not used in the comparisons. The estimated sizes of fish that would be caught by flag gill nets were based mainly on the length frequency distributions of fishes caught by flag gill nets. Table 29 summarizes the estimates of the fish population as determined by rotenone poisoning and shows the number of fish as well as the sizes which were considered large enough to be caught by flag gill nets. In some instances the minimum sizes which were considered large enough to be caught by flag gill nets are not actually the minimum size the flag gill nets are capable of catching but are the minimum size occurring in the samples taken by rotenone poisoning which were considered large enough to be caught by the flag gill nets.

Commercial fish and other fish were much more relatively abundant in the flag gill net samples than in the samples obtained by rotenone poisoning (Table 30). However, game fish were considerably more relatively abundant in the rotenone samples than in the flag gill net samples. A test of homogenity of the proportion of different kinds of fish occurring in the 2 types of samples were significant (Table 30). This shows that the flag gill nets are highly selective for certain kinds of fish, *i.e.*, if the rotenone sampling data are considered as being non-selective. The other

Table 29. - Occurrance of total fish and fish considered large enough to be caught by flag gill nets in eighteen - one acre rotenone samples of the fish population taken during 1955 from Lake Bistineau.

	Total Fish			Fish considered of a size large enough to be caught by flag gill nets			Minimum size (in inches) of fish occurring in rotenone samples considered large enough to be caught by flag gill nets
	Total number	Number per acre	Percent of total number	Total number	Number per acre	Percent of total number	
Yellow bullhead	260	14.4	0.1	11	0.6	0.5	6.5
Channel catfish	---	---	---	---	---	---	---[4]
Blue catfish	---	---	---	---	---	---	---[4]
Flathead catfish	2	0.1	---[1]	1	0.1	---[1]	10.0
Bowfin	---	---	---	---	---	---	---[4]
Fresh-water drum	10	0.6	---[1]	10	0.6	0.4	---[2]
Spotted gar	10	0.6	---[1]	10	0.6	0.4	15.0
Shortnose gar	6	0.3	---[1]	6	0.3	0.3	---[2]
Alligator gar	---	---	---	---	---	---	---[4]
Longnose gar	4	0.2	---[1]	4	0.2	0.2	---[2]
Smallmouth buffalo	11	0.6	---[1]	11	0.6	0.5	---[2]
Black buffalo	---	---	---	---	---	---	---[4]
Spotted sucker	---	---	---	---	---	---	---[4]
Lake chubsucker	79	4.4	---[1]	4	0.2	0.2	9.0
River carpsucker	---	---	---	---	---	---	---[4]
Largemouth bass	472	26.2	0.2	122	6.8	5.3	7.5
Spotted bass	3	0.2	---[1]	2	0.1	0.1	7.5
White crappie	3	0.2	---[1]	1	0.1	---[1]	5.5
Black crappie	481	26.7	0.2	150	8.3	6.5	5.5
Bluegill sunfish	34,412	1,911.8	14.6	1,369	76.1	59.1	4.5
Redear sunfish	11,249	624.9	4.8	26	1.4	1.1	5.0
Warmouth sunfish	30,070	1,670.6	12.8	84	4.7	3.6	5.5
Longear sunfish	34	1.9	---[1]	---	---	---	---[3]
Spotted sunfish	2,163	120.2	0.9	71	3.9	3.1	4.0
Orangespotted sunfish	143	7.9	0.6	---	---	---	---[3]
Bantam sunfish	6,802	377.9	2.9	---	---	---	---[3]
Yellow bass	13	0.7	---[1]	8	0.4	0.3	6.5
Chain pickerel	50	2.8	---[1]	20	1.1	0.9	13.0
Golden shiner	1	0.1	---	---	---	---	---[3]
Gizzard shad	1,436	79.8	0.6	404	22.4	17.4	6.5
Threadfin shad	147,055	8,169.7	62.4	---	---	---	---[3]
Pirateperch	758	42.1	0.3	---	---	---	---[3]
American eel	3	0.2	---[1]	---	---	---	---[3]
Tadpole madtom	17	0.9	---[1]	---	---	---	---[3]
Other fishes	4	0.2	---[1]	4	0.2	0.2	---[2]
Total number	235,551	13,086.2	---	2,318	128.8	---	---

[1] Less than 0.05

[2] All fish were considered to be large enough to be caught by the flag gill nets

[3] None of the fish were considered to be large enough to be caught by the flag gill nets

[4] Did not occur in the rotenone samples

Table 30. - Composition of the percent composition of the various kinds of fish caught by flag gill nets with the percent composition of the various kinds of fish occurring in rotenone samples. Only fish occurring in the rotenone samples which were considered to be of a size large enough to be caught by flag gill nets were used in the comparison. The relative compositions are expressed as percent of total number.

	Gill nets	Rotenone samples
Commercial fish	20.6	2.5
Game fish	32.9	79.9
Other fish	46.5	17.6
Total number	1940	2318
Chi-sq. = 1,008.90; degrees of freedom = 2; significant at a probability of 0.01		

Table 31. - Comparison of the relative species composition of fish caught by flag gill nets with the relative species composition of fish occurring in rotenone samples. Only fish occurring in the rotenone samples which were considered to be of a size large enough to be caught by flag gill nets were used in the comparison. The relative compositions are expressed as percent of total number.

	Gill nets	Rotenone samples
Yellow bullhead	2.0	.5
Channel catfish	.3	---
Blue catfish	.1	---
Flathead catfish	.6	---[1]
Bowfin	.2	---
Fresh-water drum	.7	.4
Spotted gar	3.7	.4
Shortnose gar	1.3	.3
Alligator gar	.2	---
Longnose gar	8.0	.2
Smallmouth buffalo	.5	.5
Black buffalo	.1	---
Spotted sucker	2.6	---
Lake chubsucker	.5	.2
River carpsucker	.1	---
Largemouth bass	2.3	5.3
Spotted bass	.3	.1
White crappie	.7	---[1]
Black crappie	4.4	6.5
Bluegill sunfish	7.2	59.1
Redear sunfish	5.9	1.1
Warmouth sunfish	2.1	3.6
Longear sunfish	.1	---
Spotted sunfish	.3	3.1
Orangespotted sunfish	.1	---
Yellow bass	7.3	.3
Chain pickerel	2.1	.9
Golden shiner	.1	---
Gizzard shad	46.0	17.4
Threadfin shad	.1	---
Other fishes	.4	.2
Total number	1940	2318
Chi-sq. = 1784.81; degrees of freedom = 30; significant at a probability of 0.01		

[1] Less than 0.05

possibility is that both types of gear are selective for different types of fish. Undoubtedly this is true to some extent.

Table 31 compares the relative species composition of the flag gill net catches and the rotenone samples. A test of homogenity of the proportion of different species of fish occurring in the 2 types of samples was significant (Table 31). Of the commercial species, all (with the exception of smallmouth buffalo) were relatively more abundant in the flag gill net samples than in the rotenone samples. Smallmouth buffalo were found in the same proportion in both types of samples. Of the game fish, spotted bass, white crappie, redear sunfish, longear sunfish, orangespotted sunfish, yellow bass and chain pickerel were relatively more abundant in the flag gill net samples. Largemouth bass, black crappie, bluegill sunfish, warmouth sunfish, and spotted sunfish were relatively more abundant in the rotenone samples. Of the other fishes (golden shiner, gizzard shad and threadfin shad) all were more abundant in the flag gill net samples.

For 2 species, the differences in the relative abundance were extreme. Bluegill sunfish comprised only 7 percent of the total number caught by flag gill nets while they comprised 59 percent of the total number recovered by rotenone poisoning. Gizzard shad comprised 46 percent of the total number caught by flag gill nets and comprised only 17 percent of the total number recovered by rotenone poisoning.

Seven species of fish, (channel catfish, blue catfish, bowfin, alligator gar, black buffalo, spotted sucker and river carpsucker) which occurred in the flag gill net catches were not represented at all, regardless of size of the fish, in the collections obtained by rotenone poisoning. However, each of these species comprised less than 1 percent of the total number of fish caught by flag gill nets - with the exception of spotted sucker which comprised 2.6 percent of the total catch. This could be interpreted to mean that sampling by rotenone poisoning is selective, however, I believe that considering the percent of the total lake area that was sampled (18 out of 17,200 acres) by rotenone poisoning; it is possible that such species, which are rare and undoubtedly distributed very patchily in the lake, could strictly through chance not occur in the sampling areas. This would be especially true for those species which made up less than 1 percent of the total catch.

Comments Relative to Proposals to Close Lake Bistineau to Commercial Fishing

Many of the sport fishermen believe that commercial fishing on Lake Bistineau is detremental to the sport fishery. Because of this, attempts have been made to close Lake Bistineau to all commercial fishing. There are no exact data available on the characteristics and size of the Lake Bistineau commercial fishery. However, according to my observations the following generalizations can be made. Three types of commercial gear are used on Lake Bistineau. These are: flag gill nets, trammel nets and hoop nets. Hoop netting is not done in the lake proper but in the tributary streams during periods of high flow. Practically all of the commercial fishing done on the lake proper is with flag gill nets; therefore, only the flag gill net fishery need be considered. It was evident to me while working on Lake Bistineau that some illegal wire traps were fished in the lake; however, it is not known how extensive this is. This type of fishing is already illegal and closing the lake to commercial fishing would have no effect on this.

Under some conditions, a reduction in the abundance of non-game species can be beneficial to sport fishing. However, for the removal of non-game fish from a lake to have any chance of affecting the abundance of game fish, it is necessary that the non-game species comprise a substantial portion of the total population and that a substantial portion of these non-game fish be removed. There is no evidence that commercial fishes are overabundant in Lake Bistineau (Table 29). I doubt that either restricting or allowing commercial fishing on Lake Bistineau will have much affect on the fish population (Lambou 1959b). Nevertheless, commercial fishing should be allowed since it utilizes a resource that would otherwise be wasted. I know of no valid reasons why the lake should be closed to commercial fishing.

I would recommend a minimum legal size of 3.0 inch square mesh for gill nets fished on Lake Bistineau. This is based on 2 considerations: (1) the catch of game fish in the various mesh sizes and (2) characteristics of the commercial fishery. This minimum mesh size is consistant with the recommendations made by Davis and Posey (1960a) that a minimum size of 3.0 inch square mesh be adopted statewide in Louisiana for gill nets.

Considering data presented previously in this report, the catch of game fish in flag gill nets of 3.0 inch square mesh size or larger would be negligible. However, I would like to emphasize that there is no evidence that the catch of game fish by flag gill nets of sizes from 2.0 to 2.9 inches square mesh is detrimental to the sport fishery. Gill nets of 2.0 inch square mesh size and larger were legal when this study was undertaken. The other consideration is the size of the commercial fish caught by the various mesh sizes of flag gill nets.

The most valuable commercial fish caught in North Louisiana are the buffalo fishes. No exact data are available as to the composition of the commercial catch on Lake Bistineau, however, according to my observations it is directed primarily to the catching of buffalo fishes.

Small buffalo fishes are not of much value commercially because of the large number of small bones in the flesh and the labor involved in processing these fish. Buffalo fishes of approximately 9 pounds and larger usually bring premium prices on the market and therefore are most in demand. Of course the size at which buffalo fishes will bring premium prices will vary among the different fish dealers and with market conditions. However, all other things being equal, the market for the smaller size buffalo fishes is limited.

Table 32 through 34 shows the average size of bigmouth, black and smallmouth buffalo fishes caught in various mesh sizes and twine types and sizes of flag gill nets fished experimentally throughout Louisiana. These data are adapted from Davis and Posey (1960b). In Davis and Posey's report only the mean lengths of fish caught for each type of net were given, therefore the mean lengths were weighted by the number of fish caught in determining the mean lengths for the grouped data.

According to Davis and Posey (1960a) there if little difference in the average size of fish caught by flag gill nets in Louisiana of different twine types, i.e., nylon, cotton and linen. They were able to demonstrate significant differences in average lengths of buffalo fishes caught by flag gill nets of different twine types, but of the same mesh size, in only 2 of many comparisons (Davis and Posey 1960b). Also they were unable to demonstrate any significant differences in average size of buffalo fishes caught in flag gill nets of the same mesh size and type but of different twine sizes. Therefore, only the grouped data will be considered.

Figure 3 shows the relationship between mesh size and the mean size of buffalo fishes caught based on Davis and Posey's data. The mean size of buffalo fish caught by flag gill nets of 2.5 inch square mesh size and smaller is quite variable and no general trend is detectable. However, the average size is quite small and undoubtedly these mesh sizes will catch many buffalo fish of below legal size and of a size not desired by the market.

For sizes of 3.0 inches square mesh and larger a definite trend is detectable, i.e., the average size of fish caught increases with the mesh size. Undoubtedly these mesh sizes will catch buffalo fishes mainly above legal size and a large portion of the catch will be fish of a size desired by the market. Actually, the determination of exactly what the optimum mesh sizes of flag gill nets that should be used in order to obtain the highest sustained economic return is not possible from the available data. This would require knowledge of natural mortality rates, fishing mortality rates, growth rates, etc. However, based on the available data, I believe that a minimum size of 3.0 inches square mesh would be desirable from the standpoint of the commercial fishery.

A minimum size of 4 inch square mesh for all gill nets has gone into effect for the parishes of Bossier, Bienville, Caddo and Webster since the experimental flag gill net fishing experiments were conducted on Lake Bistineau. Lake Bistineau is located in Bossier, Bienville and Webster Parishes. However, effective May 1, 1961, a minimum legal size for gill nets of 3.0 inch square mesh came into existance statewide. I believe this minimum size of 4 inch square mesh is too large. Even though the 4.0 inch square mesh and larger mesh sizes catch a much larger average size buffalo fish than the sizes from 3.0 to 3.9 inches square mesh, these mesh sizes catch buffalo fishes of definite marketable size. If natural mortality rates are relatively high between the time a buffalo fish reaches legal size and the time it reaches the average size caught by 4.0 inch square mesh sizes, it is possible that a higher sustained yield of buffalo fish could be maintained by allowing the smaller mesh sizes (3.0 to 3.9). Also, as stated previously, the catch of game fish by mesh sizes from 3.0 to 3.9 square inches is negligible. Davis and Posey (1960b) also caught very few game fish in flag gill nets of 3.0 inches square mesh size and larger sizes.

Summary

In order to determine the efficiency

Figure 3. - Average weight of buffalo fish caught in various mesh sizes of nylon gill nets fished experimentally throughout Louisiana, adapted from Davis and Posey (1960b).

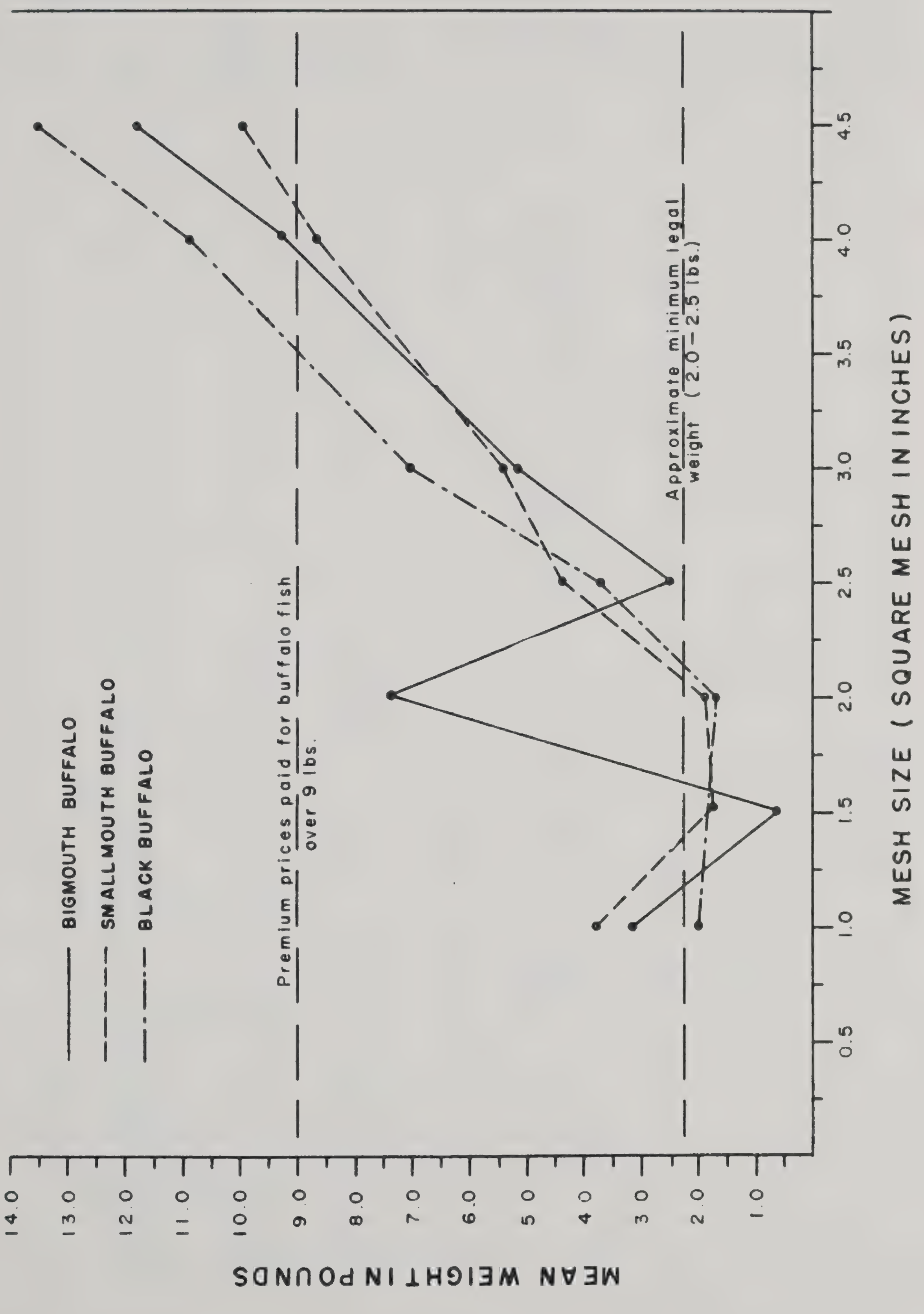
BIGMOUTH BUFFALO
SMALLMOUTH BUFFALO
BLACK BUFFALO
Premium prices paid for buffalo fish over 9 lbs.
Approximate minimum legal weight (2.0 – 2.5 lbs.)
MEAN WEIGHT IN POUNDS
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
MESH SIZE (SQUARE MESH IN INCHES)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Table 32. - Average size of Bigmouth buffalo (*Ictiobus cyprinellus*) caught in flag gill nets fished experimentally throughout Louisiana, adopted from Davis (1960b). The mean length for the sub-totals and totals represents a weighted average - see text for explanation.

Twine type or size	No.	Lbs.	Mean Weight	Mean Length
1.0 inch square mesh				
Linen				
No. 35/3	1	0.1	0.1	6.1
Nylon				
No. 69	2	9.4	4.7	12.7
TOTAL	3	9.5	3.1	10.5
1.5 inch square mesh				
Cotton				
No. 20/6	1	0.4	0.4	9.8
Linen				
No. 35/3	3	1.4	0.5	8.5
No. 18/3	3	1.6	0.5	9.0
Sub-total	6	3.0	0.5	8.8
Nylon				
No. 104	1	1.7	1.7	15.8
No. 139	1	1.4	1.4	12.6
Sub-total	2	3.1	1.6	14.2
TOTAL	9	6.5	0.7	10.1
2.0 inch square mesh				
Cotton				
No. 20/9	1	6.5	6.5	22.4
Nylon				
No. 104	5	53.3	10.7	24.4
No. 139	5	27.1	5.4	19.1
No. 208	1	1.5	1.5	13.4
No. 277	3	22.9	7.6	21.7
Sub-total	14	104.8	7.5	21.1
TOTAL	15	111.3	7.4	21.2
2.5 inch square mesh				
Nylon				
No. 139	10	24.4	2.4	17.5
TOTAL	10	24.4	2.4	17.5
3.0 inch square mesh				
Nylon				
No. 139	6	30.8	5.1	19.4
TOTAL	6	30.8	5.1	19.4
4.0 inch square mesh				
Nylon				
No. 139	51	447.8	8.8	23.0
No. 208	98	898.0	9.2	23.5
No. 277	16	161.3	10.1	24.0
No. 346	107	975.0	9.1	23.7
TOTAL	272	2482.1	9.1	19.8
4.5 inch square mesh				
Nylon				
No. 277	17	199.9	11.8	25.0
TOTAL	17	199.9	11.8	25.0

Table 33. - Average size of Black buffalo caught in flag gill nets fished experimentally throughout Louisiana, adopted from Davis (1960b). The mean lengths for the sub-totals and totals represents a weighted average - see text for explanation.

Twine type or size	No.	Lbs.	Mean Weight	Mean Length
1.0 inch square mesh				
Nylon				
No. 139	3	6.1	2.0	14.4
TOTAL	3	6.1	2.0	14.4
2.0 inch square mesh				
Linen				
No. 35/3	1	1.7	1.7	14.2
No. 18/3	2	3.2	1.6	13.6
Sub-total	3	4.9	1.6	13.8
Nylon				
No. 104	6	7.0	1.2	17.1
No. 139	1	2.6	2.6	16.1
No. 208	1	6.2	6.2	21.7
No. 277	3	4.3	1.4	13.1
Sub-total	11	20.1	1.8	16.3
TOTAL	14	25.0	1.8	15.8
2.5 inch square mesh				
Linen				
No. 35/3	1	4.5	4.5	19.3
Nylon				
No. 139	4	14.5	3.6	17.7
TOTAL	5	19.0	3.8	18.0
3.0 inch square mesh				
Nylon				
No. 139	3	21.0	7.0	21.0
TOTAL	3	21.0	7.0	21.0
4.0 inch square mesh				
Nylon				
No. 139	6	52.0	8.7	22.9
No. 208	11	117.1	10.6	24.7
No. 277	7	86.1	12.3	25.2
No. 346	19	214.0	11.3	25.5
TOTAL	43	469.2	10.9	24.9
4.5 inch square mesh				
Nylon				
No. 277	13	176.0	13.5	26.3
TOTAL	13	176.0	13.5	26.3

Table 34. - Average size of smallmouth buffalo caught in flag gill nets fished experimentally throughout Louisiana, adopted from Davis (1960b). The mean lengths for the sub-totals and totals represent a weighted average - see text for explanation.

Twine type or size	No.	Lbs.	Mean Weight	Mean Length
		1.0 inch square mesh		
Cotton				
No. 20/9	1	6.5	6.5	21.3
Linen				
No. 35/3	1	0.5	0.5	9.3
Nylon				
No. 69	3	5.0	1.7	12.4
No. 104	3	16.7	5.6	17.3
Sub-total	6	21.7	3.6	14.9
TOTAL	8	28.7	3.6	15.0
		1.5 inch square mesh		
Cotton				
No. 20/6	3	1.7	0.6	9.2
No. 20/9	2	2.1	1.1	9.4
Sub-total	5	3.8	0.8	9.3
Linen				
No. 35/3	6	4.4	0.7	10.[illegible]
No. 18/3	1	0.8	0.8	11.0
Sub-total	7	5.2	0.7	10.2
Nylon				
No. 69	5	17.5	3.5	16.5
No. 104	11	19.2	1.7	12.6
No. 139	4	8.9	2.2	13.3
Sub-total	20	45.6	2.3	13.7
TOTAL	32	54.6	1.7	12.3
		2.0 inch square mesh		
Cotton				
No. 20/6	12	9.6	0.8	10.9
No. 20/9	1	0.5	0.5	9.8
Sub-total	13	10.1	0.8	10.8
Linen				
No. 35/3	1	2.0	2.0	15.0
No. 18/3	2	1.4	0.7	10.2
Sub-total	3	3.4	1.1	11.8
Nylon				
No. 104	2	10.7	5.4	18.5
No. 139	8	20.6	2.6	15.4
No. 208	3	8.8	2.9	13.2
No. 277	5	9.3	1.9	15.4
Sub-total	18	49.4	2.7	15.4
TOTAL	34	62.9	1.9	13.3
		2.5 inch square mesh		
Linen				
No. 35/3	1	3.2	3.2	15.8
Nylon				
No. 139	8	36.5	4.6	18.5
TOTAL	9	39.7	4.4	18.2
		3.0 inch square mesh		
Nylon				
No. 139	27	142.3	5.3	18.4
TOTAL	27	142.3	5.3	18.4
		4.0 inch square mesh		
Nylon				
No. 139	14	114.7	8.2	22.3
No. 208	47	411.8	8.8	23.1
No. 277	12	85.8	7.2	21.3
No. 346	42	388.0	9.2	23.0
TOTAL	115	1000.3	8.7	22.8
		4.5 inch square mesh		
Nylon				
No. 277	16	160.3	10.0	24.5
TOTAL	16	160.3	10.0	24.5

and selectivity of flag gill nets in catching fish, experimental flag gill nets were fished in Lake Bistineau during the period March through August, 1956. Lake Bistineau, a large impoundment of 17,200 acres, has an average depth of 7 feet.

Flag gill nets differ in several important features from conventional gill nets. Flag gill nets contain no lead line and are hung on a top line which contains no floats. The experimental flag gill nets were 175 yards long and 8 feet deep and consisted of 25 yards of each of the following mesh sizes: 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.5 inch square mesh. For summary purposes the various species of fish were grouped into 3 types: (1) commercial fish, (2) game fish and (3) other fish.

The 2.0 inch mesh size had the highest catch rate while the 4.5 inch mesh size had the lowest. Commercial fish had the highest catch rate in the 1.5 inch mesh size. Even though the commercial fish were caught at the highest rate in the 1.5 inch mesh size, the more valuable commercial fishes were caught at higher rates in the larger mesh sizes. Game fish were caught at the highest rate in the 1.5 inch mesh size. The catch rates for game fish were very low for the 3.0 and larger mesh sizes. The only other fish (*i.e.*, other than commercial or game fish) which were caught in any abundance were gizzard shad. Gizzard shad were caught at the highest rate in the 2.0 inch mesh size.

It is probable that the mean catch per net day of flag gill nets fished experimentally is not a good measure of what commercial fishermen would catch using the same types of nets. In the experimental fishing of flag gill nets, an attempt was made to randomize the flag gill net sets in the lake. A commercial fisherman would not do this. Through experience he should know which are the most productive sets for the type of fish he wishes to catch and would only make such sets. Data are presented on the frequency distributions of the catches per net day which should give a somewhat better idea of the potential of the various mesh sizes of flag gill nets when fished under commercial conditions.

There were considerable differences in the relative composition of the catch among the various mesh sizes. Commercial fish were much more relatively abundant in the larger mesh sizes. Commercial fish comprised 100 percent of the total number caught by the 4.5 inch mesh size. Game fish were more relatively abundant in the smaller mesh sizes. Other fish (gizzard shad) were relatively more abundant in the medium mesh sizes.

For the most part, the mean length of the various species of fish caught increased as the mesh size became larger. The size of fish available to be caught had in many instances a definite effect on the mean length of the fish caught by the various mesh sizes of flag gill nets.

The catch of fish by flag gill nets for the period March through May was compared with the catch for the period June through August. The catch rate for total fish was highest during the first sampling period, however, the difference was due mainly to differences in the catch rates of those species which were most abundant. The catch rate for commercial fish was also highest during the first period, however, the difference in the total catch were due mainly to differences in the catch rates of those species which made up a relatively large portion of the total catch. There were significant differences in the catch rates for the individual species of game fish, but the catch rates were not consistantly more or less for either of the 2 sampling periods. Commercial fish and other fish comprised a relatively larger portion of the total catch during the first sampling period, while game fish were relatively more abundant during the second period.

The catch of fish by flag gill nets set less than 6 feet deep was compared with the catch of nets set 6 feet deep or deeper. Total fish were caught at higher rate in the shallow sets, however, the difference in the catch rates were due mainly to differences in the catch rates of those species which were most abundant. No differences could be demonstrated between catch rates of commercial and game fish in shallow and deep sets. Gizzard shad were caught at a significantly higher rate in shallow sets. A test of homogenity of proportion of different kinds of fish caught at different depths was not significant; however, a test of homogenity of proportion of different species was significant.

In order to determine the selectivity of flag gill nets, the relative composition of the flag gill net catches was compared to estimates of the relative composition of the fish population made by rotenone poisoning. Commercial fish and other fish were much more relatively abundant in the flag gill net samples. Game fish were considerably more relatively abundant in the samples taken by rotenone poisoning. This shows that the flag gill nets are highly selective for certain kinds of fish, *i.e.*, if the rotenone sampling

data are considered non-selective. The other possibility is that both types of gear are selective for different kinds of fish. Undoubtedly this is true to some extent.

Many of the sport fishermen believe that commercial fishing on Lake Bistineau is detremental to sport fishing. Because of this, attempts have been made to close Lake Bistineau to all commercial fishing.

Under some conditions, a reduction in the abundance of non-game species can be beneficial to sport fishing. However, for the removal of non-game fish from a lake to have any chance of affecting the abundance of game fish, it is necessary that the non-game species comprise a substantial portion of the total population. There is no evidence that commercial fishes are overabundant in Lake Bistineau. I doubt that either restricting or allowing commercial fishing on Lake Bistineau will have much affect on the fish population. Nevertheless commercial fishing should be allowed since it utilizes a resource that would otherwise be wasted.

I would recommend a minimum legal size of 3.0 inch square mesh for gill nets fished in Lake Bistineau. This is based on 2 considerations: (1) the catch of game fish in the various mesh sizes and (2) characteristics of the commercial fishery. It is believed that the catch of game fish by flag gill nets of 3.0 inch and larger sizes would be negligible. Even though mesh sizes smaller than 3.0 inches catch larger numbers of game fish there is no evidence that such nets would be detremental to the sport fishery. The commercial fishing on Lake Bistineau is directed primarily toward buffalo fishes. Small buffalo fishes are not of much value commercially. Mesh sizes of 3.0 inch square mesh and larger would catch buffalo fishes mainly of a size desired by the market.

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